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On the Biology of *Craticulina tabaniformis* F.,
(DIPTERA; SARCOPHAGIDAE) which breeds
in the nests of Sand wasps *BEMBEX* F.
(SPHEGIDAE).

by

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(with 3 Text Figures)

Host Relationships of Miltogrammine Flies.

Musca tabaniformis was described in 1805 by Fabricius (*Syst. Antliat.* p. 302) from Morocco, and was later made the type of the genus *Craticulina* Bezzi (1906 *Zeitschr. Hym. Dipt.* VI, p. 49). It appears to be widely distributed in Africa, having been recorded from Nyasaland and Natal. It is common in the Salisbury and Bulawayo districts from October to May. The genus *Craticulina* is included in keys to the Palaearctic and World fauna by Rohdendorf (1927) and Townsend (1935) respectively. It belongs to a group of the sub-family Miltogramminae which is associated with certain fossorial and other Hymenoptera.

The host relationships of European and American species have been discussed briefly by Allen (1926) and Townsend (1935), but very little information concerning African species is available in the literature. In Southern Rhodesia the following associations have been observed between Miltogrammine flies and Hymenoptera, the maggots living in the nests of the latter: — species of *Amobia* RD. with the mud-dauber, *Sceliphron*; of *Miltogramma* Mg. with the fossorial "wasps" *Cerceris* and *Philanthus*; of *Sphccapata* Rond. with *Sphex* (*Psammophila*) and two undetermined species with the mud-nests of mason bees, *Megachile*. During recent years the writer has studied the biology of *Craticulina* in the Salisbury district where it breeds in the nests of sand wasps, *Bembex melanopa* Handl. and *B. fuscipennis* Lep.

Nesting Habits of the Sand wasps.

Carpenter (1920) has given a charming account of the activities of some species in the vicinity of Lake Victoria, and Arnold (1929) has commented briefly on the nesting habits of some South African

species. The usual nesting haunts of sand wasps are the sandy banks of rivers, but *B. fuscipennis* and *B. melanopa* sometimes nest in large heaps of loose damp sand, as was observed at Cleveland Reservoir situated about six miles east of Salisbury.

The sand heaps are composed of washed river-sand removed from the filterbeds where it had been in use for many years. The sand contains only traces of organic matter and silt and the proportion of coarse sand to fine sand is about 60 : 1. The moisture content of a sample of sand taken on 14th May, 1938, from a nest about 8 inches below the surface was 2.7 % and it was observed that the sand did not take up moisture after being placed over distilled water (about 100 % relative humidity) at 24° C. for 24 hours. The temperature of the surface dry sand on 14th May was over 50° C. and that of a nest at a depth of about 4 inches was 20° C. The sand was acidic in reaction, the p_{H} being about 5.5.

The sand wasps pass the cold weather of the dry season, July to September, as pupae in the burrows and do not emerge in large numbers until the advent of the first rains. They are semi-social, nesting near one another within a small area on the sunny side of the sand dumps. The colonies are composed of from twenty to fifty sand wasps or more, each individual making and tending its own nest.

The nest is made at the end of a tunnel in the damp sand, and contains, usually, a single *Bembex* larva which subsists on a supply of two-winged flies brought from time to time during the day by the female *Bembex*. The sand wasp paralyses or kills the flies by injecting a venom which is said to preserve them in a fresh condition for several days. The female sand wasps range far and wide for food for their young, visiting garden flowers and the blossoms of trees and shrubs for flies which are attracted by nectar and pollen. They may also be seen catching bloodsucking flies off the bodies of domestic animals, such as cattle, and visiting carcasses of cattle and sheep for blowflies and sheep maggot flies.

The Prey of Sand wasps.

The following species of flies removed from the nests were in a suitable condition for identification:

Fam. BOMBYLIIDAE

Comptosia mollis Bezzi.

Fam. SYRPHIDAE

Erastalodes taeniops Wied.

Rhingia cocculescens Lw.

Fam. TABANIDAE

Haematopota maculans Austen.

Tabanus variabilis Lw.

Fam. MUSCIDAE

Musca interrupta Wlk.

„ *lusoria* Wied.

„ *sorbens* Wied.

Stomoxys bilineata Grün.

„ *calcitrans* L.

Fam. CALLIPHORIDAE

Chrysomyia albiceps Wied.

„ *chloropyga* Wied.

<i>Chrysomyia marginalis</i> Wied.	Fam. SARCOPHAGIDAE
" <i>putoria</i> Wied.	
<i>Cosmina aenea</i> F.	<i>Helicobia munroi</i> Crn.
<i>Hemipyrellia fernandica</i> Macq.	<i>Mitogramma cuthbertsoni</i> Crn.
<i>Lucilia cuprina</i> Wied.	<i>Sarcophaga dura</i> Crn.
<i>Rhinia apicalis</i> Wied.	" <i>exuberans</i> Pand.
<i>Rhynchomyia pictifascies</i> Big.	" <i>falciforceps</i> Vill.
" <i>pruinosa</i> Vill.	" <i>garbo</i> Crn.
<i>Stegosoma vinculatum</i> Lw.	" <i>haemorrhoidalis</i> Flin.
<i>Stomoxys haematodes</i> F.	" <i>hirtipes</i> Wied.
" <i>mitis</i> Crn.	
" <i>tricineta</i> F.	Fam. TACHINIDAE
<i>Strongylocyba (T.)</i>	<i>Stimma atropivora</i> Rl.
" <i>distinguenda</i> Vill.	" <i>delabida</i> Vill.
" (<i>Apollonia</i>) <i>tristis</i> Big.	" <i>inconspicua</i> Mg.
	<i>Zenillia colans</i> Wied.

Males predominated among the number of flies captured, and it is interesting to note that the majority were flower-visiting species. *Craticulina* was not found among the prey, though the remains (chiefly heads and wings) of several hundred flies were examined.

When the sand wasp arrives laden with prey at the hidden entrance to its nest it drops its burden and rapidly opens the burrow by scratching away the sand with its forelegs.

After disclosing the entrance and clearing the burrow, the sand wasp carries its prey into the nest and places it near the larva. On leaving, the sand wasp usually scratches sand over the entrance, but sometimes it leaves the nest open and affords an opportunity for the entrance of enemies.

Infestation of Nests by Craticulina.

The female *Craticulina* has been observed only in the vicinity of the sand wasp colonies. It flies low over the hot sand following the wasps to their nests. When a nest is left open the fly enters and deposits about five small active maggots among the stored-up flies near the *Bembex* larva.

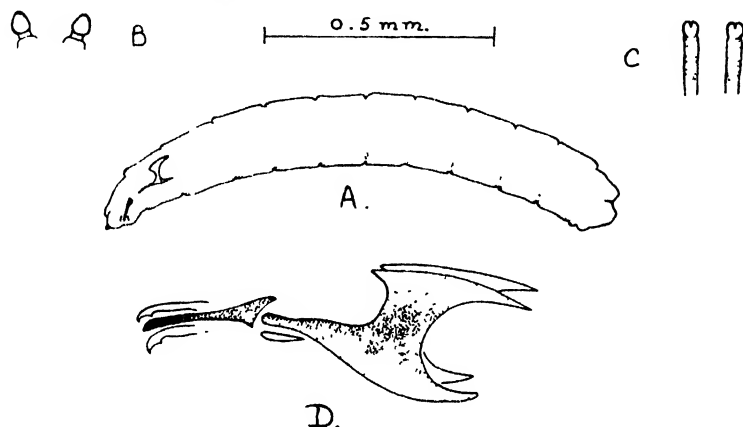
Life History of Craticulina.

The newly born maggots are in the first instar. They feed externally on the body fluids of the flies intended for the host larva. They grow rapidly and become fully-fed in about six days. The duration of the development stages under controlled conditions in the laboratory was as follows: — at 24° C. the larval stage occupied from 7 to 10 days, the pupal stage varied from 11 to 15 days; at 30° C. the first larval instar lasted 10 hours, the second larval instar 24 hours and the third larval instar occupied from 2 to 5 days.

There is a prepupal period of about one day, after which the maggots pupate in the burrow without making a cocoon.

Under natural summer conditions the flies emerge from the

puparia after ten to twelve days and make their way through the sand to the surface by protruding and deflating the bladder-like *ptilinum*. Craticulina, like *Bembex*, probably passes the cold weather of the dry season, July to September, in the pupal stage, since no flies or sand wasps were observed during that period.



Text Fig. 1. *C. tabaniformis*, first-stage larva.

- A. Lateral view.
- B. Antennae, greatly magnified.
- C. Posterior spiracles, greatly magnified.
- D. Buccopharyngeal armature.

The fecundity of the fly has not been ascertained, but from dissections of the female reproductive organs, it has been found that in gravid females about sixty larvae were contained in the large unlobed uterus, but only a small number at a time appeared to be ready for birth.

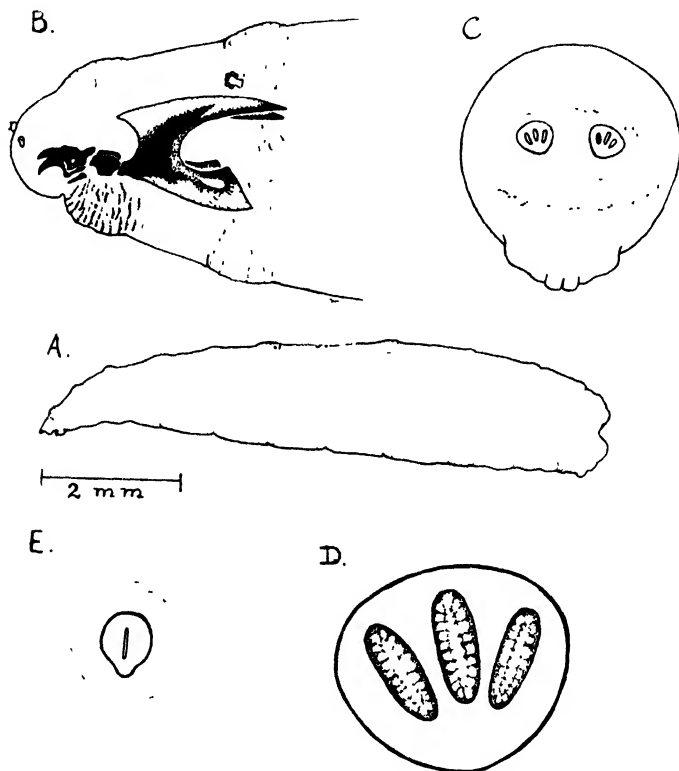
The general effect of infestation of nests by maggots of *Craticulina* is to decrease the amount of food available for the host larva. However, since the supply of food is augmented daily during the life of the *Bembex* larva, there is little danger, under natural conditions, of the latter being entirely deprived of food. The small specimens of *Bembex* occasionally encountered may be the result of malnutrition due to a decreased food supply in infested nests. Several *Bembex* larvae, which were transferred together with fly maggots to rearing jars, failed to develop, and it is possible that they were attacked by the fly maggots in the absence of sufficient food.

Description of the Immature Stages.

LARVA.

The *newly born larva* is in the first instar and is metapnaustic. It is about 1.5 mm. in length, slender and cream coloured, (Fig. 1, A.).

The body is composed of twelve distinct segments, viz., head, three thoracic and eight abdominal segments. The segments each bear on the anterior margin a transverse band composed of short lines of uncoloured microscopic points. The antennae and posterior



Text Fig. 2. *C. tabaniformis*, third-stage larva.

- A. Lateral view.
- B. Anterior end showing buccopharyngeal armature.
- C. Terminal segment showing posterior stigmata.
- D. Left spiracular plate, greatly magnified.
- E. Anal plate.

spiracles are shown in Fig. 1, B. C. The buccopharyngeal armature has one median and two lateral hooks typical of Miltogrammine larvae, and the hypostomal and pharyngeal sclerites are weakly developed, (Fig. 1, D.).

The *second instar larva* is slender, about 3.5 mm. long, and is amphipneustic. It has not been studied in detail.

The *third instar larva* (Fig. 2) when mature is robust, cream

coloured, and about 10 to 12 mm. long. It is composed of a cephalic, three thoracic and six apparent abdominal segments, and the rugose bands on the segments are not conspicuous. The anterior spiracles are situated on the posterior part of the first thoracic segment and usually have six papillae or lobes. The posterior spiracles are in a shallow depression on the upper half of the posterior segment, the spiracular plates (Fig. 2, C.) being widely separated. The peritreme of the spiracular plate is thin, the three slits are short and almost vertical (Fig. 2, D.). The ridge around the stigmata has no fleshy processes, but is surrounded with rugose areas. The anal plate is small and pear-shaped, (Fig. 2, E.). The buccopharyngeal armature is shown in Fig. 2, B.

PUPARIUM.

The puparium is large, about 8.5 mm. in length, the underside is concave and the anterior and posterior ends are evenly rounded. As the pupa develops the colour of the puparium darkens from a light testaceous to a mahogany brown. The surface is smooth except for faint indications of rugose bands, as in the last larval instar. The posterior spiracles are placed on the upper part of the posterior segment. The spiracular plates in appearance are much as in the larva, but the area round the slits and at the 'button' is dark.

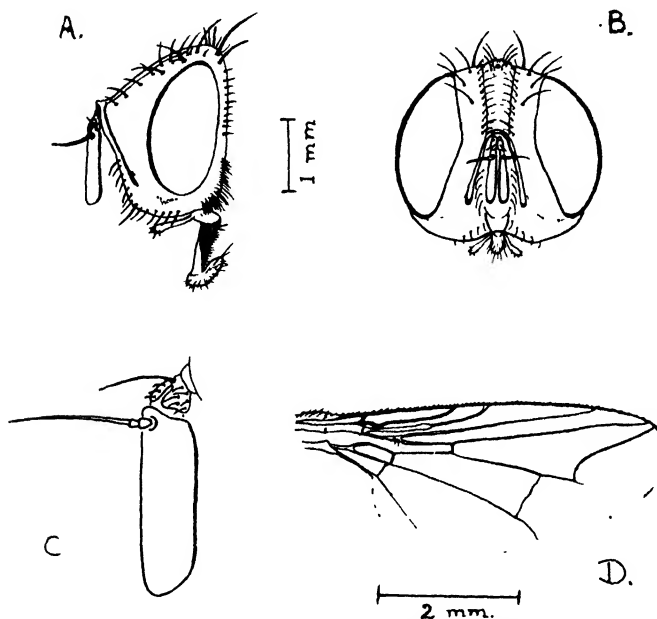
ADULT (Fig. 3).

Some of the most noticeable features of the female fly are as follows: — the body is narrow, 8.5 mm. long, and the eyes are bare. The frontal stripe is broad and amber coloured, the orbits and cheeks are shining white, the orbits with two pairs of frontoorbital bristles directed forward. The antennae, which are situated in the facial depression, are light testaceous, the arista is porrect, bare, light testaceous basally but dark on the distal half. The proboscis is conspicuous and protruding, with fleshy labella furnished with hairs, the maxillary palps are slender and clublike. The thorax is cinereous, with one pair of acrostichal and two pairs of dorsocentral bristles behind the suture, and one pair of praesutural intraalar bristles. The pleura are grey pruinose. The femora and tibiae are testaceous and covered with grey pollen, the tarsi are dark. The abdomen is testaceous, chequered with whitish pruinose areas. The dorsum has a dark irregular marking on the centre near the hind margin of each segment, which is conspicuous on the second and third apparent segments. The wings, 5 mm. in length (Fig. 3, D.) are hyaline, the veins basally yellowish but becoming darker distally. The 1st posterior cell is open and has a spur. The 3rd longitudinal vein has several bristles at the base. The colour of eyes in life is brick red.

The male is not known to the writer.

Acknowledgements.

The writer is pleased to have this opportunity of expressing his thanks to Dr. G. Arnold, Director of the National Museum of Southern Rhodesia, Bulawayo, for his interest in the investigation, and for identifying the sand wasps mentioned in this paper.



Text Fig. 3. *C. tabaniformis* (female).

- A. Side view of head.
- B. Front view of head.
- C. Antenna, greatly magnified.
- D. Wing.

The fly was determined by Dr. F. van Emden of the Imperial Institute of Entomology, London. Dr. A. J. Hesse of the South African Museum, Cape Town, kindly compared Rhodesian specimens of *C. tabaniformis* with those from South Africa, and supplied bibliographical information. Mr. R. McChlery of the Chemistry Branch, Department of Agriculture, Salisbury, analysed a sample of sand from the nests of *Bembex melanopa* and supplied information on moisture content and texture.

Thanks are due to Mr. J. W. Jarvis, Acting City Engineer, and to Mr. A. H. Bell, Superintendent of Cleveland Reservoir for facilities granted during this investigation.

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202, 210, 213.

Notes on Ceratopogonidae (Dipt. Nematocera) from Southern Africa

by

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All the types of the species described below have been deposited in the collection of The South African Institute for Medical Research.

Forcipomyia wansonii sp. nov.

Male.

A small, almost black species with unornamented wings and legs. *Wing length.* — 1.0 mm. *Head.* — Eyes very narrowly separated above by less than the width of one facet: clypeus and mouth parts brown; vertex dark brown. *Palps.* — Five-segmented but segments IV and V nearly fused; segment III very slightly expanded near the middle without a sensory pit; the relative lengths of the segments are, II, 8; III, 18; IV + V, 17. *Antennae.* — Tori very dark brown, rest of the segments brown; segment XV with a prominent style; the relative lengths of the segments, including the style of XV are:

Segment	3	4	5	6	7	8	9	10	11	12	13	14	15
Length	15	8	7	7	7	7	7	7	7	26	15	11	15

Mesonotum. — Dark brown, shiny, shoulders slightly paler. *Scutellum.* — As mesonotum with a row of eighth bristles. *Legs.* — Straw coloured without any banding; the relative lengths of the tibiae and tarsi are:

		Tarsi					
Segment	Tibia	1	2	3	4	5	
Fore leg	92	30	22	17	15	12	
Mid leg	92	27	23	17	14	12	
Hind leg	88	35	30	22	17	12	

Hind tibia with a subapical row of about seven and an apical row of six bristles; first hind tarsus with a number of moderately stout colourless spines; claws small, equal; empodium prominent. *Wing.* (Fig. 1, b) Unicolourous, densely and evenly clothed with macrotri-

chia without any obvious bare spaces along the veins but with a very small bare spot at the end of the costa; the costa ends at about the middle of the wing; first radial cell absent, second very small, barely indicated, not square-ended; fork of the cubitus slightly beyond the end of the costa. *Halteres*. — Dark stalks with creamy knobs. *Abdomen*. — Dark brown, shiny. *Terminalia* (Fig. 1, a). Ninth

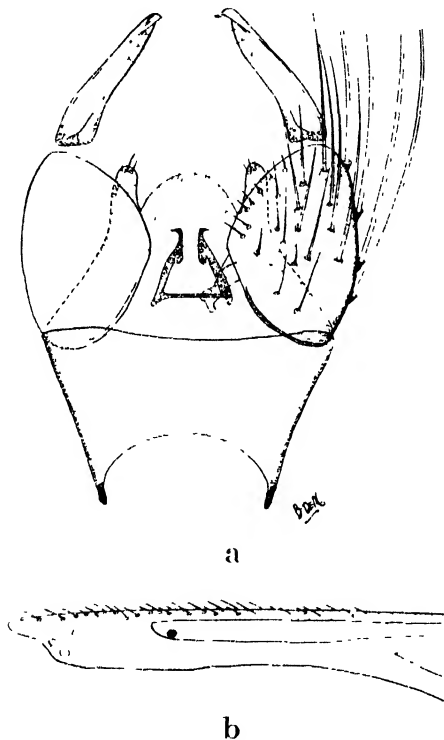


Fig. 1. *Forcipomyia wansonii* sp. nov.:
a. male terminalia; b. end of the costa
in the male wing

sternite constricted basally, almost straight or slightly concave apically; tergite somewhat conical in shape medially with a process at each apical angle; side-pieces short and broad; claspers tapering but gradually to a somewhat blunted apex; parameres apparently absent or invisible in this specimen which was cleared for a few minutes in lactochloro-phenol and not subjected to maceration in potash; aedeagus of two narrow strips of chitin joined basally by a narrow bridge.

1 Male, Luadi, Belgian Congo (M. Wanson) 2. ix. 37.

This species is somewhat related to *nigeriensis* Ing. & Macfie, of which the female only is known, but differs in the shiny mesonotum, shortness of the costa and smaller size. In Goetghebuer's 1935 key to the Congo species it comes near *nigricoxis* Goetgh. but differs in many respects, notably colour and antennal and tarsal measurements.

***Alluaudomyia maculithorax* Carter, Ingram & Macfie.**

1921. *Prionognathus maculithorax* C., Ing. & Macfie, Ann. Trop. Med. & Parasit., 14, 319. (Accra, Gold Coast.)
 1935. *Prionognathus maculithorax* C., Ing. & Macfie, Goetghebuer, Rev. Zool. Bot. Afr., 27, 33. (Rutshuru, Belgian Congo).

Carter, Ingram and Macfie described the male only. Goetghebuer gave a short description of the female which, however, is misleading as far as the wing structure is concerned because both his figure and description really apply to the male except that he mentions the larger size of the female wing and the presence of more abundant macrotrichia apically. In the specimens before me the costa extends much beyond the middle of the wing and the fork of the cubitus (Fig. 2, a) I have no doubt that these specimens are *maculithorax*. Dr. Wanson reared several males and females; the former agree with the description of Carter, Ingram and Macfie and the pupal pelts of the two sexes are inseparable.

I take this opportunity of supplementing Goetghebuer's short description of the female and also describe the larva and pupa.

Female.

Wing length. — 1.36 mm. *Head.* — Eyes very narrowly separated above. *Palps.* — Third segment not distinctly swollen and with a very small sensory pit; the relative lengths of the three terminal segments are: III, 9; IV, 7; V, 10. the terminal segment is slightly club-shaped being wider apically than basally. *Antennae.* — The relative lengths of the antennal segments are:

Segment	3	4	5	6	7	8	9	10	11	12	13	14	15
Length	12	8	9	10	11	11	11	11	15	15	17	16	20

Segments IV—XIII are more or less flask-shaped. *Pharynx.* — The pharynx is of the same distinctive structure as described by the writer ¹⁾ for *A. maculosa* De Meill. *Scutellum.* — With four bristles. *Wing.* — (Fig. 2, a.) Somewhat larger than in the male and with more abundant macrotrichia apically; the costa is relatively longer the ratio to the total wing length being 47 : 68, it ends well beyond the fork of the cubitus and just before the end of the upper branch of that vein. *Legs.* — First tarsal segment

relatively longer than in the male and the fourth more expanded; claws markedly unequal on all legs (Fig. 2, b.); as in the male the first kind tarsus is approximately half the length of the tibia.

Spermatheca. — Single, pear-shaped, almost colourless, measuring approximately $88\mu \times 60\mu$.

Several males and females, Luadi, Belgian Congo, (Dr. M. Wanson) 2. ix. 37, reared from larvae taken in stagnant water containing much organic matter.

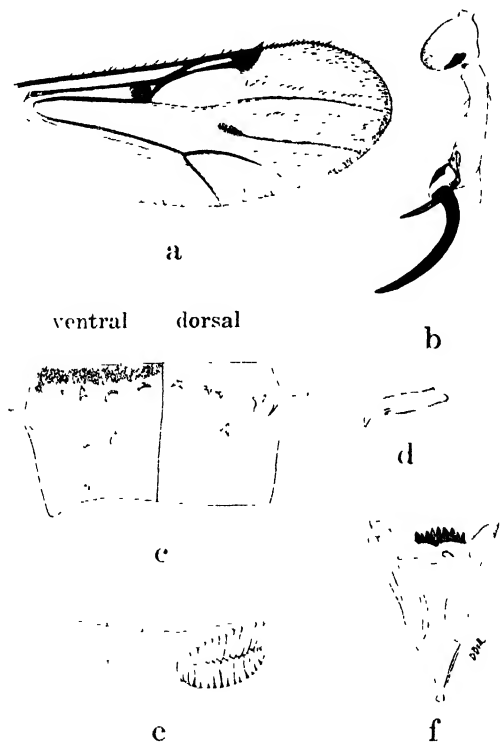


Fig. 2. *Alluaudomyia maculithorax* C., 1. & M.: a. female wing (fringe not shown); b. tarsi IV and V of the midleg; c. segment V of pupa; d. mandible of larva; e. respiratory trumpet of pupa; f. hypopharyngeal sclerite of larva.

Pupa.

Cephalothorax. — With a number of large tubercles dorsally and numerous small bosses which are especially prevalent on the operculum; all setae very minute and delicate or absent; anterior marginal tubercle apparently unarmed; anterior

dorsal and dorso-lateral tubercles small, each with a very delicate hair and a minute spine; dorsal tubercles unarmed or only with minute spines. *Respiratory trumpet*. — (Fig. 2, e) Slightly expanded apically and about 0.8 mm. in length its structure is best understood from the figure. *Abdomen*. — (Fig. 2, c.) All segments with a few minute spines along the basal margin, apically each segment is sculptured bearing a number of small closely placed irregular plates each plate bearing a minute nodule; the abdominal tubercles are small and arranged very much as in the genus *Culicoides*; each segment except the eighth and ninth has two pairs of dorsal antero-submarginal tubercles bearing minute setae or delicate hairs; the dorsal postero-marginal tubercles are similar; the most conspicuous tubercles are the lateral postero-marginal of which one is quite large and sharply pointed; the ninth segment has a pair of fairly long, slightly divergent, sharply pointed terminal processes; the ventral tubercles are also small.

Larva.

Included amongst the material were a number of larvae of which one was about to pupate and the respiratory organs of the pupa could be clearly seen. I have no hesitation therefore in ascribing these larvae to *maculithorax*. The larva is a brownish, eel-like insect with a densely pigmented head and resembles the larva of the genus *Culicoides* in shape. The body, except the terminal segment, is, however, completely devoid of hairs or bristles. The cuticle is ornamented with a number of small brown dots of pigment. *Head*. — The clypeal plate is somewhat darker than the rest of the head capsule; the antennae and palps are very small and colourless and their precise structure is difficult to make out; the mandibles (Fig. 2, d.) are quite large and bent, their precise shape, as that of the hypopharyngeal sclerite (Fig. 2, f.), will be best understood from the figures. *Abdomen*. — Terminal segment with four very long setae at the dorsal apical angle and two pairs of smaller ones ventrally, the rest of the abdominal segments apparently quite nude. I could find no trace of anal gills which, however, were probably retracted when the larvae were placed in preserving fluid.

***Monohalea mimas* sp. nov.**

Male.

A medium-sized species with spotted wings and mesonotum ornamented; hind legs enlarged with the tibiae conspicuously black. *Wing length*. — 1.2 mm. *Head*. — Vertex dark brown; clypeus and mouth-parts straw-coloured; eyes bare, widely separated above. *Palps*. — Segments I, II, and V somewhat darker than the rest;

III only very slightly expanded with a sensory pit; V. somewhat club-shaped; the relative lengths of the segments are II, 8; III, 12; IV, 10; V, 14. *Antennae*. — Tori dark brown the rest straw-coloured except XII—XV which are almost black; verticils yellowish except apically where they are very dark; III—XI more or less fused so that their lengths cannot be given with certainty; the relative lengths of the terminal segments are XII, 10; XIII, 22; XIV, 21; XV, 26; XV drawn out terminally to a blunt point. *Mesonotum*. — Humeral calli yellowish; notum somewhat shiny, greyish with brown markings which tend to give it a spotted appearance, clothed with small yellowish hairs and some long black bristles posteriorly and above the wing roots. *Scutellum*. — Yellow with two central bristles close together and one lateral marginal on each side. *Halteres*. — Yellowish throughout. *Wings*. — (Fig. 3, a.) Conspicuously marked with dark patches; costa approximately three-quarters of the wing length; second radial cell about twice the length of the first; base of the lower branch of the median interrupted; fork of the cubitus just before the cross vein; whole wing-field totally devoid of macrotrichia; allula with one or two hairs. *Legs*. — (Fig. 3, b.) Coxae yellowish except apically where dark brown; femora brown, those of the fore and mid legs narrowly dark at the base and apex, hind femora enlarged, broadly black at the apex and narrowly dark basally, all femora unarmed; fore and mid tibiae brownish those of the hind leg enlarged, black, shiny; all tarsi brownish with some small black spines on the anterior legs and with very heavy black spines on the hind legs as follows: one at the base and apex of the first, two at the apex of the second and in addition the first has row of closely set colourless spines along its anterior margin; claws on the anterior legs short, equal and simple, on the hind legs single enormously enlarged, longer than the fifth segment. *Abdomen*. — Tergites I—IV broadly yellowish in the middle rest dark brown, shiny; sternites yellowish except apically where dark brown. *Terminalia*. — (Figs. 3, c, f, & g.) Tenth sternite produced in the middle with an incision along the apical margin into which the base of the aedeagus appears to fit; tergite narrow with two small apical marginal processes; side piece very long, slightly narrowed at the apex; clasper bent almost at right angles near the base; aedeagus and parameres rather complicated and best understood from the figures.

1 male, bred from a pupa collected in a stream amongst grass, St. Lucia, Zululand, 4. xii. 37. (C. V. Meeser.)

Pupa.

Cephalothorax. — (Fig. 3, d.) There are six well developed dorsal tubercles and two on the operculum, these tubercles are

covered with small nodules but otherwise are without any hairs or setae, nor do any hairs or setae appear to be present on any other portion of the integument. *Respiratory Organ.* — (Fig. 3, h.)

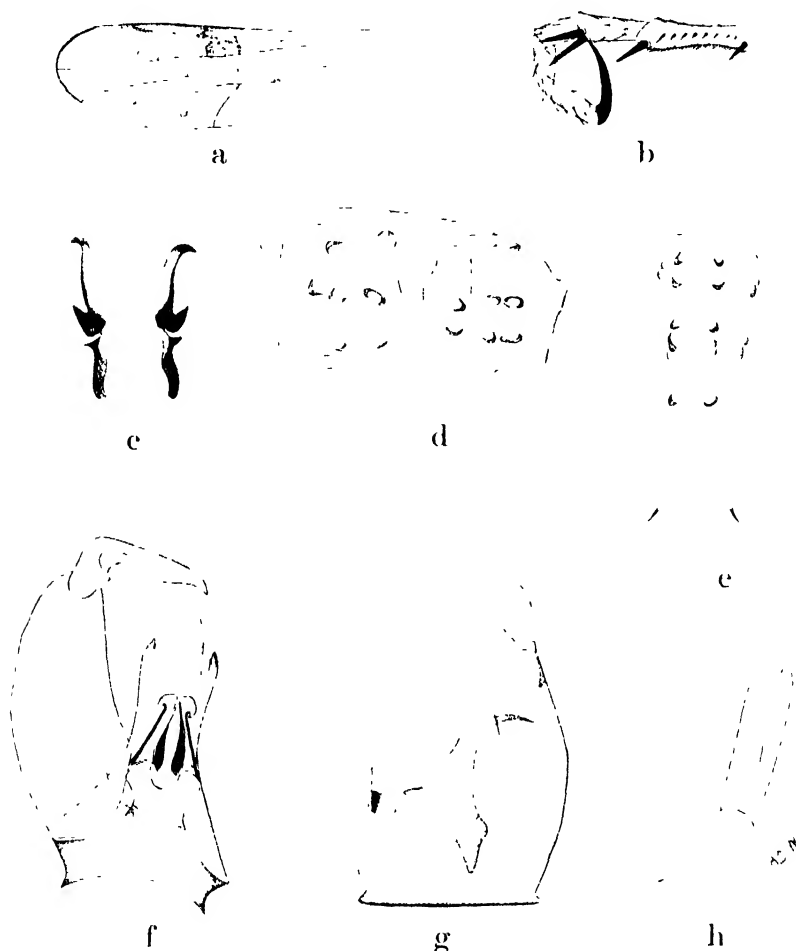


Fig. 3. *Monohylea minus* sp. nov.: a. male wing (fringe not shown); b. tarsi of the hind leg; c. parameres, ventral view; d. cephalothorax and abdominal segments I & II of the pupa; e. abdominal segments VI—IX of the pupa; f. male terminalia in ventral view, parameres not shown; g. male terminalia in side view, side-pieces not shown; h. respiratory trumpet of the pupa.

Small, measuring about 0.6 mm. in length and of even width throughout, mounted on a prominent pedestal, there is one lateral tracheal opening and about five apical ones arranged fan-wise. *Abdomen.*

— (Fig. 3, e.) The abdominal segments are provided with tubercles resembling those on the cephalothorax, no hairs or setae could be discovered anywhere; dorsally each segment except the eighth and ninth bears two pairs of large tubercles, laterally there is one pair; the ninth segment is long and provided with a prominent pair of backwardly directed, slightly divergent, processes.

Ventrally there are no tubercles. The whole of the ventral and dorsal surfaces is covered with minute transparent spines which are not very dense.

This insect is related to *litoraurea* Ingram and Macfie and *nigeriae* Ingram and Macfie, both of which, however, are known from females only. The present species may well be the male of either. It differs in several respects e.g., hind femora black at the apex, rest brown and tarsal segments III and IV without heavy spines.

***Monohelea meeseri* sp. nov.**

Male.

A medium sized dark species with ornamented wings. *Wing length.* — 1.7 mm., greatest width, 0.5 mm. *Head.* — Eyes widely separated, bare; vertex and clypeus almost black, shiny; palps and antennae brown; verticils dark apically. *Palps.* — Third segment slightly swollen with a sensory pit; segments IV and V slender, V broader apically than basally and nearly twice as long as IV. *Antennae.* — Unfortunately lost during the process of mounting. *Mesonotum.* — Very dark brown, shiny, with some greyish patches punctuated with small dark brown dots. *Pleurae.* — Largely dark brown. *Scutellum.* — Slightly paler than the mesonotum especially laterally, with two central bristles and one lateral on each side. *Halteres.* — With clear stalks and waxy white crowns. *Legs.* — Mainly dark brown; femora of fore and mid legs darkened apically and with an ill defined paler area just below the middle; hind femur much darker and with a well defined pale band near the middle, slightly swollen; tibiae of fore and mid legs brown, slender; tibia of hind leg enlarged, black, shiny; tarsi straw-coloured but darker on hind legs; the legs are armed as follows: — tarsus I of fore legs with an apical, a basal and a median black bristle; tarsus I of mid legs with two basal, two apical and a row of five or six median black bristles; tarsus II and III of the mid leg each with a pair of rather weak apical black bristles; tarsus I of hind leg with a stout black bristle basally and apically and a row of closely set colourless spines in between; tarsus II of the hind leg with a pair of stout black spines apically; claws on the fore and mid legs small, equal, each with a small slender subbasal barb; on the hind legs consisting of one long claw nearly twice as long as

tarsus V and one small one not half as long as tarsus V. *Wing*. — (Fig. 4, a.) Ornamented with dark areas as in figure; ratio of costal length to wing length 1:1.3; second radial cell one and a half times as long as the first; median with a short stalk; fork of the cubitus under the cross vein; wing surface devoid of macrotrichia;

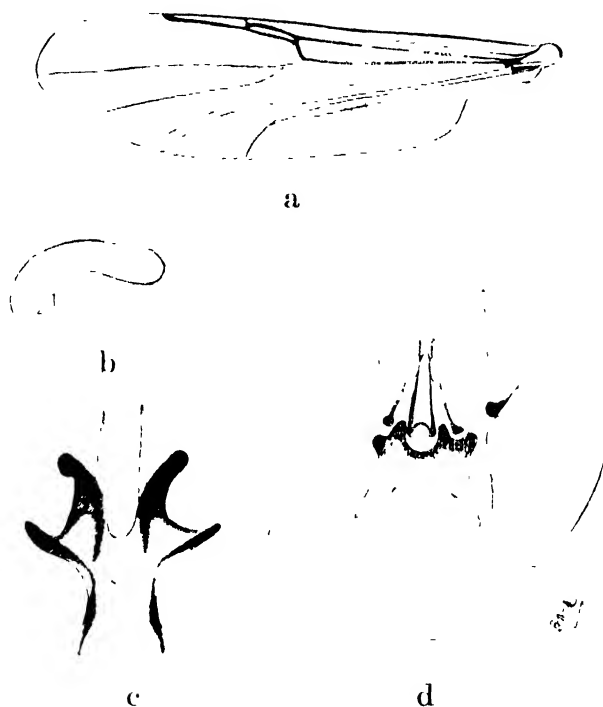


Fig. 4. *Monohelea neeseri* sp. nov., a. Male wing (Fringe not shown); b. Clasper; c. Parameres, ventral view; d. IXth. segment, aedeagus and a portion of one clasper.

alula bare. *Abdomen*. — Light brown basally and dark brown apically. *Terminalia*. — (Fig. 4, b, c & d.) Very dark brown and well pigmented; IXth tergite narrows suddenly before the middle and with two lateral lobes; sternite strongly produced in the middle between the side-pieces, heavily pigmented apically where it is excavated in the middle to receive the aedeagus; side-pieces slightly longer than the IXth tergite each with a prominent internal apodeme connected with the lateral arms of the parameres; claspers somewhat rounded apically and of almost even width throughout; aedeagus complicated and appears to consist of three plates, one ventral fits

in basally into the excavation of the IXth sternite on each side of this lie the other two at right angles to the first, these two plates are serrated internally at their apices; parameres, fused, complicated, consisting essentially of a large plate with a pair of long basal arms and two pairs of lateral arms the upper ones of which appear to connect with the internal apodemes of the side-pieces, in addition there is a pair of sharply pointed processes projecting dorsally.

Holotype. — 1 Male, taken at light, Eshowe, Zululand, 7. i. 38.

This insect is named in honour of Mr. C. V. Meeser who has rendered valuable help in collecting S. African *Ceratopogonidae*.

***Stilobezzia intermedia* sp. nov.**

Male.

A very shiny black species with unspotted clear wings. *Wing length*. — 1.4 mm. *Head*. — Eyes bare very narrowly separated above; vertex and mouth parts very dark brown; clypeus and tori brown. *Palp*. — Long and thin, third segment not swollen, no sensory pit; the relative lengths of the segments are: III, 18; IV, 10; V, 20. *Antennae*. — Brown with black verticils; the relative lengths of the terminal segments are: 13: 15: 45: 54: 76. *Mesonotum*. — Very dark brown, shiny, with some long black bristles; shoulders with a greenish tinge. *Scutellum*. — With two central and one lateral marginal on each side; colouration similar to that of mesonotum. *Halteres*. — Pale stems with very dark knobs. *Pleurae*. — With a greenish tinge. *Wing*. — As in the female (Fig. 5, a.) *Legs*. — Straw-coloured throughout; base of the first tarsus of mid leg with one and apex with two short spines, apex of the second tarsus with two short spines; leg segments otherwise unarmed except for the usual „bulbous” hairs on the first and second tarsal segments; second segment of hind leg approximately half as long as the first; claws small, equal. *Abdomen*. — Jet black, very shiny, but first tergite greenish. *Terminalia*. — (Fig. 5, b.) Small; tIX broad and short with two small apical lobes; side-pieces hardly as long as the tergite; claspers bent near the middle, shorter than the side-pieces, gradually tapering; aedeagus largely membranous but side walls pigmented in the form of two narrow strips of chitin; parameres large, well pigmented, bent near the middle, rounded apically and with a small subapical spine.

Female.

General colouration as in the male. *Antennae*. — Long and narrow; XI—XV together longer than III—X the ratio being approximately 31 : 20; the relative lengths of the terminal segments are: 32 : 30 : 35 : 35 : 51. *Pharynx*. — As described for the genus

by the writer but two basal papillae of the oesophageal pump missing. *Wing*. — (Fig. 5, a.) Length 1.4 mm.; no macrothichia, costa reaches 0,1 of the length of the wing; median with a long stalk; end of Cul opposite the end of the costa; clear without any ornamen-

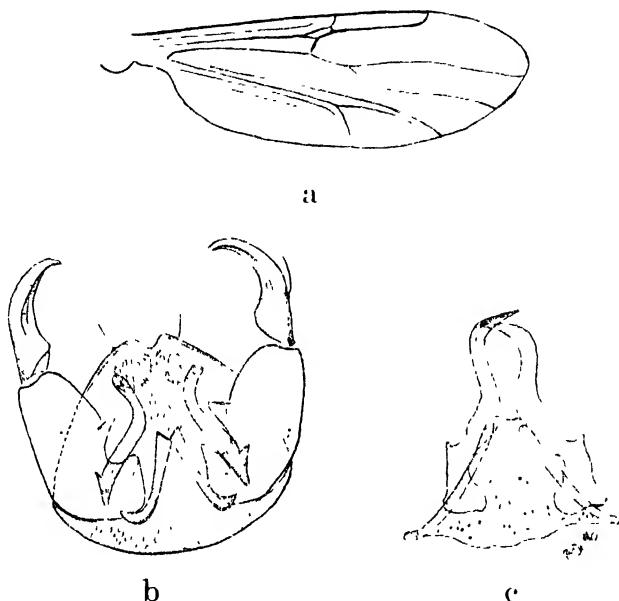


Fig. 5 *Stilobezzia intermedia* sp. nov.: a, female wing (fringe not shown); b, male terminalia; *Stilobezzia flavirostris* (Winn.): c, aedeagus and parameres of male terminalia.

tation; alula with a row of hairs. *Lcgs*. — As in the male but tarsus V of fore and mid legs with a pair of long, black, blunt-tipped spines; claws markedly unequal on all legs. *Spermatheca*. — Single, feebly pigmented, measuring $60\mu \times 48\mu$; duct not pigmented.

2 males and 2 females hatched from pupae collected in a slow-moving stream, St. Lucia, N. Zululand, 4. xii. 37.
(C. V. Meeser.)

This species is somewhat related to *parvula* Goetgh. from Belgian Congo but scutellum very dark and segment XV of antenna nearly $1\frac{1}{2} \times$ XIV. In colouration and wing structure this species agrees exactly with the European *flavirostris* (Winn.). The differences I am able to discover are: Kieffer (2) gives the relative lengths of the terminal segments of the male antenna as

13 : 15 : 38 : 37 : 50 whereas in the present species they are 13 : 15 : 45 : 54 : 76. Winnertz (3) gives a figure of the male palp in which the terminal segment is very short whereas in the present species this segment is very long and thin, longer than the fourth and about as long as the third. Due to the kindness of Dr. F. W. Edwards I have been able to examine a male of *flavirostris* from Wicken Fen, and significant differences are observable in the male terminalia. In *flavirostris* (Fig. 5, c) the parameres are very much bent apically and more gradually pointed and the strips of chitin along the sides of the aedeagus are narrower.

Stilobezzia natalensis sp. nov.

Male.

A very dark brown, unornamented species. *Wing length.* — 1.2 mm., greatest width 0.24 mm. *Head.* — Eyes separated, bare; vertex, clypeus and mouth parts light brown. *Palps.* — Third segment not swollen, without a sensory pit; terminal segment club-shaped nearly twice as long as the fourth and about as long as the third. *Antennae.* — Tori very dark brown rest paler; verticils not appressed but nearly erect much as in some *Chironomidae*; the relative lengths and widths of the segments are:

Segment	3	4	5	6	7	8	9	10	11	12	13	14	15
Length.	16	8	8	8	8	8	9	10	13	13	12	10	15
Width.	7	8	7	6	6	6	6	5	5	5			—

The last three segments are somewhat collapsed so the measurements are not accurate. *Mesonotum.* — Very dark brown, shiny, almost bare, mesonotal pits prominent. *Scutellum.* — As mesonotum but slightly lighter laterally, with four bristles centrally and a lateral one each side and also some small hairs. *Haltercs.* — Light brown throughout. *Legs.* — Femora dark brown rest straw-coloured; slender and unarmed except for some moderately stout tarsal spines as follows: — one at the apex of tarsus I of the fore leg, one at the base and two at the apex of tarsus II of the mid legs, two at the apex of tarsus III and one at the apex of tarsus IV of the mid legs, one at the apex and one at the base of tarsus I of the hind leg and a row of closely set colourless spines in between; hind tibia with a long apical spur; fourth tarsi cordiform; claws moderately long, simple, equal. *Wings.* — (Fig. 6, a). Colourless, unornamented; ratio of costal length to wing length 1 : 1.5; second radial one and three quarter times as long as the first; median with a moderately long stalk; fork of the cubitus below the cross vein; wing surface devoid of macrotrichia; alula fringed. *Abdomen.* — Dark brown throughout especially the terminal segments. *Termi-*

nalia. — (Fig. 6, b, c & d.). Complicated and well pigmented; IXth tergite short, narrowed apically, with a pair of small lateral apical lobes and a pair of median apical ones; sternite deeply excavated the membranous part spiculate; side-pieces well developed of almost

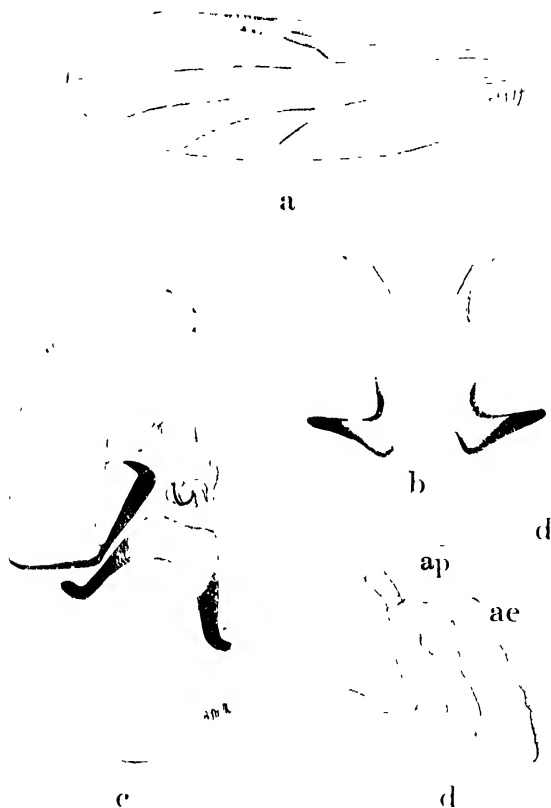


Fig. 6. *Stilobezzia natalensis* sp. nov.: a. Male wing (Fringe not shown); b. Parameres in ventral view; c. IXth. segment, aedeagus and clasper with apodeme and side-piece of one side; d. Tedeagus, parameres and apodeme of side-piece, side view: p. paramere; ap. apodeme; ae. aedeagus.

even width throughout; clasper tapering to end in a short beak-like termination; aedeagus complicated and best understood from the figures giving lateral and ventral views; parameres large, just joined medianally; in addition there are a pair of large dark processes which appear to be completely fused internally with the side-pieces and are probably abnormally developed apodemes.

Holotype. — 1 Male, Taken at light, Eshowe, Zululand, 7.i.38.

This species is somewhat like *parvula* Goetghebuer, from the Belgian Congo but differs as follows: — the second radial cell less than twice the first, scutellum not yellow, alula fringed.

***Bezzia flavicorporis* sp. nov.**

Male.

A strikingly coloured midge with mesonotum, scutellum and pleurae very dark and abdomen largely yellow. *Wing length*. — 1.7 mm. *Head*. — Vertex black or very dark brown; clypeus and palpi dark brown, proboscis black; eyes widely separated above. *Antennae*. — Tori and segments III and IV and XII — XV dark, rest yellowish, verticils yellow; the last four segments somewhat elongated their relative lengths being: XII, 7; XIII, 1; XIV, 5; XV, 5. *Mesonotum*. — Black, not shiny, with greyish reflections. *Pleurae*. — Very dark brown, shiny. *Scutellum*. — Black with two bristles near the middle and a lateral one on each side; postnotum black. *Halteres*. — Crowns and most of the stalk brown, base yellow. *Legs*. — Coxae very dark brown; fore femur largely brown, slightly darker sub-basally, armed with three heavy black spines; middle femur brown, narrowly black at the apex, unarmed; hind femur brown, narrowly black at the apex, unarmed; fore tibia infuscated apically and with a median dark band; middle tibia broadly black at the base and narrowly so at the apex; hind tibia as in the mid leg but dark and light areas more clearly defined; tarsi yellowish but IV and V slightly darker. *Wing*. — (Fig. 7, a). Unadorned, without macrotrichia, ratio of costal to wing length 1 : 1.4; fork of the cubitus beyond the cross vein; alula bare. *Abdomen*. — Yellow except for a small median and lateral brownish spot on each tergite and the terminal segments which are shiny black, sternites without these brown spots. *Terminalia*. — (Fig. 7, b, c & d). Very well pigmented throughout; IXth tergite narrow throughout, the apical median portion membranous; sternite excavated apically; the membrane spiculate, it appears to be fused to the bases of the side-pieces; side-pieces well developed but short and stout; claspers tapering to end in a sharp point; aedeagus with a dorsal projection apparently connected with the parameres; parameres fused, very long.

Female.

A single female obtained at the same time resembles the male in colouration, except that the mesonotum appears to be more greyish. As in the male the fore femur is armed with three strong black spines and the other femora unarmed. Claws simple and equal

on all legs. *Wing length.* — 1.9 mm., and the ratio of costal to wing length 1 : 1.4; fork of the cubitus just beyond the cross vein. Segments XI—XV of the antenna elongated, the terminal segment

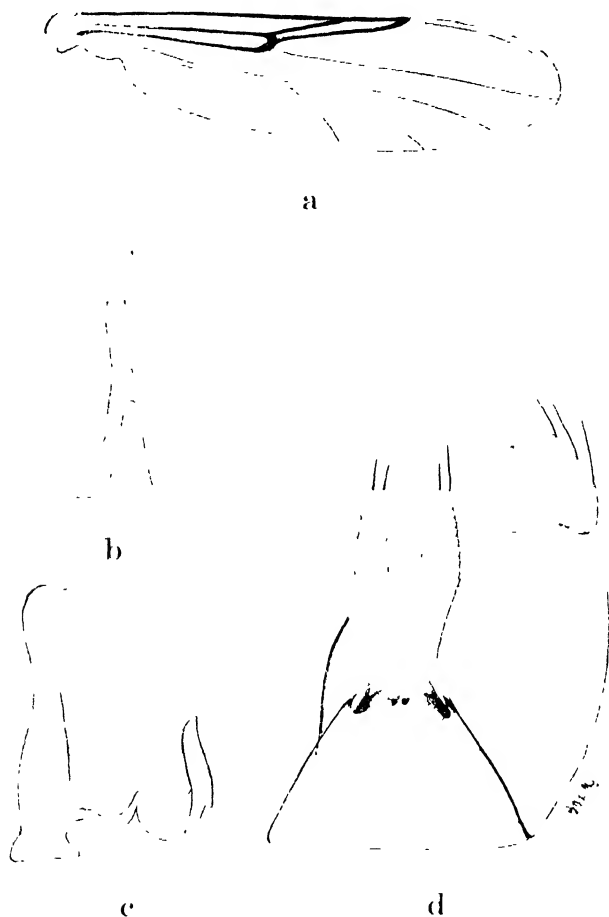


Fig. 7 *Bezzia flavicorporis* sp. nov.: a. Male wing (Fringe not shown); b. Parameres in ventral view; c. Aedeagus and parameres in side view; d. IXth. segment, aedeagus and clasper and side-piece of one side.

slightly longer than any of the others, III—X shorter in length than XI—XV combined. Because of its striking colouration the insect was not prepared for microscopic examination and so accurate measurements of the antennal segments cannot be given.

1 Male, 1 female, bred from pupae collected in the Umlalazi River, Eshowe, Zululand, 27. xi. 37.

***Bezzia lucida* sp. nov.**

Male.

A small dark species with whitish wings, the wing veins very feebly indicated. *Wing length.* — 1 mm., greatest width 0.3 mm. *Head.* — Eyes widely separated, bare; vertex and clypeus almost black, mouth parts very dark brown. *Palps.* — Small, third segment not enlarged, with a small sensory pit. *Antennae.* — Tori black, segments IV—XII brown with yellowish verticils, XIII—XV blackish; the relative lengths of the terminal segments are XI, 15; XII, 24; XIII, 11; XIV, 12; XV, 16. *Mesonotum.* — Very dark brown with some ill defined greyish reflections, no frontal tubercle, with short bristles and a few larger ones above the wing roots. *Scutellum.* — A shade paler than the mesonotum, with two bristles near the middle and a lateral one on each side. *Halteres.* — Straw-coloured throughout. *Legs* — Femora dark brown slightly paler in the middle, on the hind femur there is a definite median pale band; fore femora each armed with two short, stout, black bristles other femora unarmed; fore tibiae dark with a subapical and subbasal pale band, mid and hind tibiae with a median pale band; tarsi I—III straw-coloured, IV slightly infuscated, V dark brown; IV about as long as wide not distinctly cordiform; I—III of hind legs with „bulbous” hairs, I of mid legs with two apical black spines and II of mid legs with one apical black spine; claws small and equal. *Wing.* — (Fig. 8, a). Wing veins very poorly developed and only visible after staining; ratio of costal to wing length 1 : 1.5; fork of the cubitus well beyond the cross vein; wing surface devoid of macrotrichia; alula bare. *Abdomen.* — Clear, brown basally and shiny black apically. *Terminalia.* — (Fig. 8, b, c & d.) Well pigmented throughout; IXth tergite narrowed apically without any lobes, sternite deeply excavated; side-pieces short of almost even width throughout; claspers well developed tapering gradually to a sharp point; aedeagus folded and best understood from the figures; parameres well developed, fused, with prominent basal arms, slightly expanded apically.

Holotype. — 2 males, bred from green moss, June 1937, Matadi, Belgian Congo. (Dr. M. Wanson).

The immature stages of *Bezzia* are usually considered to be aquatic; the present record is therefore of some interest. Accompanying this species were some *Dasyhelea inconspicua* Ing. & Macfie and *D. omozantha*? Ing. & Macfie also bred from green moss, which Dr. Wanson tells me, he uses for breeding species of *Phlebotomus*.

The terminalia are like that of *flavicorporis* sp. nov. described elsewhere in this paper but the aedeagus is quite different.

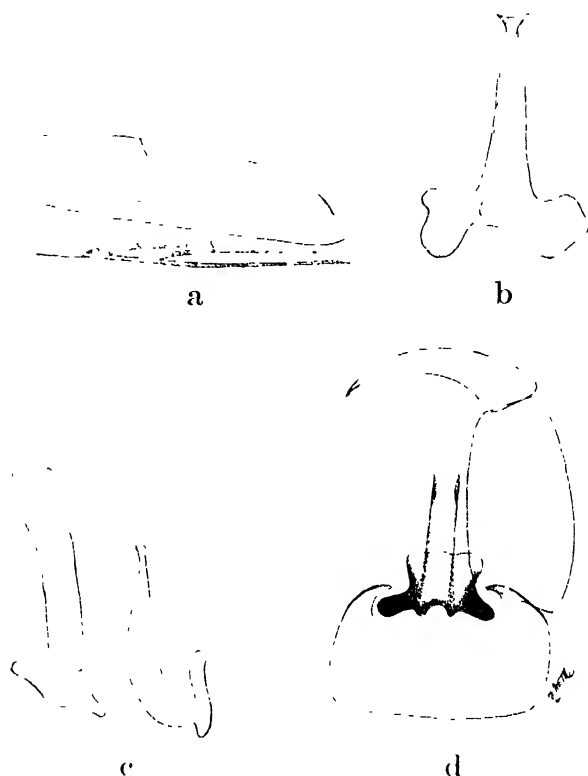


Fig. 8. *Bezzia lucida* sp. nov.: a. Male wing (Fringe not shown); b. Parameres; ventral view; c. Aedeagus and parameres, side view; d. IXth sternite, aedeagus, side-piece and clasper of one side, ventral view.

References.

1) De Meillon, B.: Studies on insects of medical importance from Southern Africa and adjacent territories (Part IV) p. 391. Publ. S. Afr. Inst. med. Res. 7, 1937, pp. 301—411.

(2) Kieffer, J. J.: Faune de France. 1925, ii, 91.

(3) Winnertz, J.: Beitrag zur Kenntnis der Gattung *Ceratopogon*, Meigen. Linnaea Entomologica, 1852, vi, taf. 1, fig. 20.

Studies in African Trypetidae, with Descriptions of New Species.

H. K. MUNRO, B. Sc., F.R.E.S.

Dacus (*Afrodacus*) *lucidus*, sp. n.

It differs from *biguttulus*, Bez. in having only one inferior orbital bristle, the scutellum yellow and upper cross-vein infuscated; from *nigrivenatus*, Mro., which also has one inferior orbital, by the spots on the face and the absence of strong, silvery, submedian stripes on the thorax.

Holotype male, allotype female and two female paratypes Mossel Bay, Cape Province, vi-vii. 1930, R. E. Turner (in British Museum, one paratype female retained).

Total and wing-length in both sexes, 5.5 mm. An entirely pale ferruginous species, only humeri and a short, narrow mesopleural stripe (not crossing notopleural suture) yellow; head paler and legs straw-coloured. *Head* normal, frons yellow, about one-third width of head, rather widened anteriorly, slight pale pubescence, one superior and one inferior orbital bristle, no ocellars; lunule short; antennae a little longer than face, which has pair of round black spots just above epistome. *Thorax* with pale pubescence; pre-scutellar bristles present, but no anterior supra-alars, one pair scutellars; hind edge of scutellum straight, the bristles as far apart as length of scutellum; halteres yellow. Legs: hind tibiae a little darkened. Wing: stigma yellow, extreme base of marginal cell infuscated also its outer end beyond stigma followed by a very narrow costal stripe enlarged a little over end of third vein; upper cross-vein broadly infuscated; anal stripe moderate; point of anal cell in male 1.5 and in female 1.3 times length of rest of sixth vein, the point widened a bit in middle; strong cloud at end of sixth vein. *Abdomen* broad, about one-third its own width wider than thorax, strongly punctate, segments free; pubescence pale; third segment ciliate, second with narrow, slightly yellow, bare, hind edge. Base of ovipositor short, 1.0 mm.

Dacus (*Didacus*) *venetatus* sp. n.

Similar to *D. fuscatus*, Wied., and *D. brevistriga* Walk. but base of ovipositor very short and median and lateral post-sutural stripes on thorax.

Holotype ♂, allotype ♀, 7 ♂♂, 9 ♀♀ partypes, Duivelskloof, Northern Transvaal, December 1936 W. G. H. Coaton (in fruits of *Adenia senensis* — one of the most poisonous plants in South

Africa); 1 female paratype, Gatooma. Southern Rhodesia, xii. 1927. A. Cuthbertson.

Length, ♂ 7.5 mm., of wing 6.5 mm.; ♀ 8.0 mm., of wing 7.0 mm. *Head*: occiput light ferruginous, with yellow orbits; frons ferruginous, the yellow on sides broken by strong brown sub-integumentary spots at the two lower and the single upper orbital bristles, the middle pair of spots palely connected across frons, shining blackish across vertex, parallel-sided, three-eighths width of head; lunule moderate; antennae about as long as narrow cheeks; face with broad, flat keel and pair of shining black spots more or less drop-shaped; palpi brownish; proboscis short.

Thorax ferruginous, golden pubescence and faint grey dust on dorsum; strong median and lateral post-sutural stripes present, the latter touching a short yellow stripe on inner ends of suture, the narrow, yellow, mesopleural stripe only reaching to notopleural bristle; scutellum yellow except two-fifths ferruginous at base. Bristles: no middle scapulars, no anterior supra-alars and no pre-scutellars, but two apical scutellars. Pleura ferruginous, black before mesopleural stripe, with pale pubescence and moderate dust most noticeable obliquely. Legs: front femora ferruginous except at base, middle entirely and hind on outer third; tibiae ferruginous; tarsi yellow, distal three ferruginous. Wing: Stigma pale yellowish brown; along costa a very pale infuscation in marginal and submarginal cells, extending broadly over upper cross-vein and forming a more definite spot before end of third vein; further, the infuscation extends almost all over the wing, generally more strongly in the discal cell; anal stripe strong and black. Point of anal cell a little more than twice length of rest of sixth vein in both sexes, the point somewhat narrowed at base, the sides more or less parallel. *Abdomen* with golden pubescence, third segment ciliate; ferruginous, the first segment black, posterior oval areas in male rather small and blackish, with short pubescence, in female large and yellow. Genitalia and venter ferruginous. Base of ovipositor very short, 1.0 mm., wide and conical (flat in most specimens) barely projecting beyond end of abdomen.

Dacus (Didacus) viator, sp. n.

A blackish species very similar to *Dacus brevis*, Coq., but differs in the shorter point of the anal cell in both sexes and the more heavily, black-marked dorsum of the abdomen.

Type ♂ and ♀, 2 ♂♂, 6 ♀♀ paratypes, Pretoria (near De Wildt), February 1936, H. K. Munro and C. C. Hattingh; 2 ♂♂ paratypes, Pretoria (Lynwood) 2.4.35, H. K. Munro; 1 ♀ paratype, Pretoria (Rosslyn) 26.9.31, W. J. Sim (bait trap); 1 ♀ paratype, Rustenburg, T. P., March 1932, A. J. Smith (bait trap); Durban, 1 ♂, 2 ♀♀, September 1932, 4 ♂♂, October 1933, W. E. Marriott (bait trap); Cedara,

Natal, 1♀, April 1932, L. B. Ripley (bait trap); Kokstad, Transkei, 2♂♂, 2♀♀, 16.1.33, H. Eagle (bait trap).

♂♀. Length ♂, 5.5 mm., ♀, 5.7 mm., of wing in both 5.0 mm. *Head*: occiput brownish with yellow orbital margins, frons brownish yellow, ocellar dot black and strongly developed, reddish-brown, sub-integumentary orbital spots, the middle pair joined to a large median spot, a spot below eye (in more or less bleached, bait-trap specimens the frons is more yellow in front and the spots tend to be absent). Bristles black, two inferior and one superior orbital, ocellars absent or minute, hair-like. Lunule reddish. Antennae ferruginous, third joint black at tip and twice length of second. Face yellow, a pair of round, shining black spots touching epistome; cheeks narrow, genae about width of third antennal joint; palpi light reddish yellow; proboscis short.

Thorax ferruginous, yellow markings are: humeri, broad mesopleural stripe to dorsocentral line above and on to sternite below, single hypopleural spot, and scutellum the last with a ferruginous base; on dorsum a wide black, median stripe widening to scutellum, on this stripe moderate white dust except for a narrow median streak bare; pleura ferruginous in front, black before mesopleural stripe, hind parts and sterna largely black. Post-scutellum black, lightly white dusted. Bristles normal, middle scapulars present and two scutellars, no anterior supra-alars. *Legs* pale ferruginous, inner halves of femora more yellow and hind tibiae and tarsi brownish. Wing normal; stigma black, end of marginal cell yellowish hyaline, no costal stripe between end of second vein and semicircular apical spot, no anal stripe but a strong cloud at end of sixth vein in male. Upper cross-vein in line with tip of stigma or just beyond, and the length of the lower from the latter. Point of anal cell short, in male 1.4 times length of rest of sixth vein, in female as long, rather wide and barely enlarged at middle. *Abdomen*. Male: oval, segments fused, base ferruginous, basal half of second segment black the large yellowish fascia on outer half divided by a ferruginous area in the middle; third segment ciliate (in one specimen the fourth segment is also ciliate on the one side), black, except small outer anterior corners reddish and slightly so in middle of hind margin, rest of abdomen ferruginous with a large black spot on each side of fourth segment extended more or less on to fifth, and a rather wide median stripe reaching fore edge of fifth segment only. Pubescence pale yellowish. Posterior oval areas more reddish. Venter yellowish, sternites and genitalia ferruginous. Female: as male, but black spots on fifth segment absent or generally small. Base of ovipositor wide conical, short, barely projecting beyond fifth segment.

Biology. In the fully-formed buds on some plants of *Brachystelma barberiae* (Asclepiadaceae) collected by Mr. C. C.

Hattingh, the author noticed the presence of Trypetid larvae. The plants were found in some numbers to the north of the Magaliesberg near De Wildt in the Pretoria district towards the end of January, 1936; they are low-growing, less than a foot high, and have one or two bunches of fifteen to twenty flowers. These are rather like those of the well-known *Stapeliae*, but the five points of the petals are long drawn-out and remain joined together at their tips, forming a basket; the flowers have a strong and very objectionable smell. The buds have a bulbous base and a long narrow neck, and it is in some of them that the larvae are found, one in each. The larvae burrow into and feed on the thicker base of the buds, and as each bud contains relatively little food, even for one maggot, as soon as one bud is consumed, the maggot makes its way out and bores into another, a remarkable habit. It is probable that the larval stage is short as it seems only full-grown buds are attacked, and as once the buds are full-sized they open rapidly, the larva must develop very quickly. The pupal stage was only twelve days, pupation taking place in the soil. The adult flies must be long-lived, as the plant only flowers once a year, and the flowering period is short so that they have to survive till the following season. It did not appear that there could be two generations of the fly within the one flowering period, but it might be possible if this were for some reason of longer duration.

Dacus (Didacus) eminus, sp. n.

A species with fused abdominal segments, no anterior supra-alar bristles and no hypopleural spots, allied to *aspilus*, Bez. (with which *langi*, Curr. may be synonymous), and *attenuatus*, Coll., but with smaller apical spot on the wing and a short, median, yellow, post-sutural stripe.

Holotype ♂, Rosslyn, Transvaal, September 1931, J. M. Sim (bait-trap), paratype ♂, Durban, August 1932, W. E. Marriott (bait-trap).

Length 8.0 mm., of wing, 6.0 mm. *Head*: light ferruginous, frons about half width of head, one superior and two inferior orbital bristles; antennae: second joint one and three-fifths, third, three times as long as first, the second and third together as long as cheek; face with pair of moderate sized, round, black spots; *Thorax*: finely punctate, ferruginous; pale yellow pubescence; humeri with yellow spot in front, yellow mesopleural stripe reaching dorso-central line; scutellum yellow with moderate ferruginous base, the two bristles as far apart as length of scutellum; legs ferruginous, except metatarsi and approximately inner halves of all femora. *Wing*: stigma dark brown, marginal cell entirely brown as is apical spot reaching from just before tip of second vein to just past end of fourth — the spot may be paler on its lower half; anal stripe strong, brown, the point twice length of rest of sixth vein. *Ab-*

domen: segments fused, twice as long as wide, rather more coarsely punctate than thorax, entirely ferruginous, third segment ciliate; sternites ferruginous, membranes yellow; genitalia ferruginous, the exposed aedeagus in the paratype appears to be rather long.

***Dacus (Didacus) siliquilactis*, sp. n.**

This species is very like *D. vertebratus*, Bez., but two characters appear to be of constant value in separating them. There is always a short, but distinct, yellow, median, post-sutural stripe, absent in *vertebratus*; unfortunately many specimens are pinned in the centre of the thorax, and this stripe is thus more or less obscured. Then, in *vertebratus*, facial spots are always well-defined and round, moderately large to rather small and on the lower part of the face; in this species they tend to be less defined, are always large and oval, almost filling the grooves. In all other characters the species is almost identical with *vertebratus*, there being a similar range of variation as far as may be ascertained from the material available. It may be noted that *mimeticus*, Coll.¹⁾ seems almost to be identical with *vertebratus*; when his description is compared with a good series of *vertebratus* and the range of variation is taken into account, the only differences that remain are apparently the length and the coloration of the pubescence on the dorsum of the abdomen.

This new species is based on a series of specimens reared by Mr. H. Hargreaves, Government Entomologist, in Kampala, Uganda, from larvae in the pods of the plant *Asclepias semilunata* (known there as „kafumbo”). There are: — ♂♂, holotype and 2 paratypes, January 1935, 2 paratypes, April 1932, 8 paratypes June 1935; ♀♀, allotype and 5 paratypes, January 1935, 2 paratypes April 1932, one, November 1934, and 7 June 1935. Material has been returned to Mr. Hargreaves, the types later to be placed in the British Museum; a few paratypes have been retained.

Head as in *vertebratus*, but the facial spots are large; one superior and two inferior orbital bristles; the third antennal joint is about five times as long as wide, but measurements such as these may be deceptive. *Thorax* with post-sutural, median, yellow stripe, humeri and double hypopleural spot yellow, the mesopleural stripe, if anything, rather narrower than in *vertebratus*. The wing-pattern in the specimens is not very strong, probably owing to their rather teneral condition. Normally it may be darker, but possibly not as well-defined as in *vertebratus*; the costal stripe and apical spot less pronounced and the stigma generally more

¹⁾ Collart, *Bull. Mus. r. d'Hist. nat. de Belgique*, xi, 43, f. 13, (1935).

transparent yellow, the point of the anal cell about the same. *Abdomen* with the usual black markings developed to a greater or lesser extent. The base of the ovipositor is on the whole rather longer, but not very markedly so, than in *vertebratus*; measurements compared with the wing-length were variable and tend to lose their value in poor specimens; it is on an average about 1.3 mm.

***Dacus (Metidacus) delicatus*, sp. n.**

A species allied to *Dacus (Metidacus) lotus*, Bez., but differs in having a moderate oval spot at the tip of the wing.

Holotype ♂, Durban, 1—7.7.33, W. E. Marriott (bait-trap), allotype ♀, Van Reenen, Natal (Drakensberg, 6500 ft.), 10. 1926, R. E. Turner (in British Museum).

♂, length, 6.2 mm., wing, 5.5 mm., ♀, length, 6.4 mm., wing 6.0 mm. *Head*: occiput dark yellowish with yellow orbital margins; frons, flat, yellow with slight sub-integumentary lateral spots, slight pale pubescence, two inferior and one superior orbital bristles, no ocellars; antennae about twice length of short face, which has a median tubercle. *Thorax* reddish in specimen, probably normally more ferruginous; a median black stripe divides on hind portion into a pair of moderate sub-median spots, laterally is a black mark over notopleural suture and before the rather narrow, yellow, mesopleural stripe, also another black mark behind notopleural suture and below base of wing, and one below fore coxae; post-scutellum and upper hypopleural spot black, except ferruginous bar across top of former; the other yellow marks are humeri, single hypopleural spot and scutellum except reddish base of last. Bristles: two apical scutellars, anterior supra-alars, but no middle scapulars and no prescutellars. Halteres yellow. Legs yellow, but distal fourths of all femora ferruginous. Wing with pale yellowish tinge, stigma deep yellow, the brown, oval, apical spot filling end of sub-marginal and upper, outer corner of first posterior cell from midway between ends of second and third veins to end of fourth vein; no anal stripe, no cloud at end of sixth vein and no super-numerary lobe on wing of male; point of anal cell one third longer than rest of sixth vein. *Abdomen*: oval; segments fused; third not ciliate; first segment black, second red (ferruginous), of the rest, the third is almost entirely black, only ferruginous on each side of median black stripe that extends to hind end of abdomen, laterally the black extends very broadly on the sides of the fourth segment, and rather less so on sides of fifth; pubescence pale, on posterior oval areas, very fine. Genitalia and venter yellowish to ferruginous.

Female similar to male, but more ferruginous as it has not been in alcohol; the black markings on the abdomen are not quite so conspicuous, although the yellow fascia on second segment is more

noticeable. Point of anal cell widened in middle and as long as rest of sixth vein. Base of ovipositor ferruginous, short, 1 mm. in length.

Dacus (Dacus) doryloides, sp. n.

A remarkable and curious species with fused abdominal segments and anterior supra-alar bristles, a large abdomen, and on the wing a narrow costal stripe and both upper and lower cross-veins infuscated. It does not appear to be closely allied to any of the known African Dacinae. It calls to mind the species placed in *Psilodacus*, but these have no anterior supra-alar bristles, nor third segment ciliate in the male. However, even if this segment is not ciliate in this species, it is probably not near *Dacus (Metidacus) lotus*, Bez.

Holotype a female, Mossel Bay, Cape Province, April 1921, R. E. Turner (in British Museum).

Length 8.0 mm., of wing, 6.7 mm. *Head* light ferruginous, rather spherical, as long as high and one third wider, the eyes relatively small so that the occiput behind and face in front are rather conspicuous; occiput with a row of strong, short bristles on either side of the neck; frons flat, yellow in front, with pale pubescence, three-eighths width of head; lunule wide and short; antennae: first joint short, second and third joints about as long as height of head, third one-fifth wide as long; face yellowish with large, round, black spot on each side; palpi somewhat spatulate, apparently without strong setulae; proboscis short; cheeks about as wide as third antennal joint, genae four times as wide. *Thorax* reddish ferruginous; narrow anteriorly and rather more than one and a half times as wide at outer of the posterior supra-alar bristles; punctate, with a pair of sub-median dusted stripes on which punctation is less; pubescence pale; suture a narrow, smooth streak on each side. Yellow are humeri, broad mesopleural stripe (which does not cross notopleural suture nor on to sternite below) and single hypopleural spot, also scutellum except a narrow ferruginous base. Halteres yellow. Legs pale. Bristles black, anterior supra-alars present, but no middle scapulars nor prescutellars. *Wing*: upper cross-vein beyond middle of discal cell; stigma yellowish, a costal stripe filling marginal cell, then a moderate stripe along costa gradually widening to tip of fourth vein; upper and lower cross-veins infuscated, anal stripe present; Point of anal cell about twice width of vein, gradually tapering at outer end, 1.6 times length of rest of sixth veins.

Abdomen large, wider than thorax, rather broadly elongate oval, the sides more or less parallel; segments fused; entirely ferruginous with whitish pubescence; base of ovipositor 1.3 mm., short conical.

Perilampus Bez.

Bezzi, 1920, *Bull. Ent. Res.*, **10**, 233; 1924, *op. cit.* **15**, 76 and 104; 1924, *Ann. S. A. Mus.*, **19**, 471 and 482.

Genotype: *Carpophthoromyia pulchella*, Austen.

In considering this genus, it seems that Bezzi rather stressed the so-called „lateral keels” of the scutellum as a distinguishing character. An examination of the genotype, *pulchella*, Aust., shows that in this species the disc of the scutellum is flat, forming at the sides an „edge” which is somewhat conspicuous as a ridge or keel in certain lights; in other species it is hardly apparent at all, and the most that can be said is that the disc is flatter than is the case in *Trirhithrum*. Two important characters distinguish this genus, particularly from *Trirhithrum*: the point of the anal cell is shorter or at most hardly longer than the second basal, and the third and fourth veins are slightly, but fairly gradually, divergent outwardly (parallel in *Trirhithrum* or only slightly widened at their tips). There is usually a double hypopleural spot, but it may be absent; the scutellum yellow, rarely black margined. On the dorsum of the thorax the transverse bars of white pubescence are rather characteristic but may form a single patch as in some species of *Trirhithrum*, a pattern sometimes being apparent. In the last genus the arista tends to be plumose, while in *Perilampus* it is little more than long pubescent or bare. The wing-pattern is as a rule well-defined, but tends to be diffuse in the males of some species.

Biology. Species that have been reared all infest the fruits of species of *Loranthus*, a micro-environment difficult to imagine suitable for dipterous larvae on account of the very sticky latex. The larvae pupate in the soil, and often become enveloped in a pseudo-cocoon owing to the adhering sand-grains.

The puparium has a characteristic shape, the anterior end being obliquely truncate above. The circular disc thus formed constitutes the operculum, and comes off in one piece when the fly emerges.

Table of Species.

- 1 (21) Wing-pattern more heavily marked, the medial band strong and complete, or in some males the pattern becoming diffuse and the bands not well-defined.
- 2 (6) ♂♂. Pattern slightly or rather strongly diffuse; generally brownish species.
- 3 (4) Pattern very diffuse, bands hardly perceptible; (arista?.)
♂. *amazuluana*, Mro.
- 4 (5) Pattern more diffuse, but cubital and medial bands fairly distinct outwardly; arista bare.

♂. *umbrina*, n. sp.

- 5 (4) Pattern fairly well-defined, only the medial and end of marginal bands approximated and more or less fused outwardly; last section of fourth vein strongly curved; arista bare. *♂. thyene*, n. sp.
- 6 (2) *♂♂♀♀*. Wing-pattern not diffuse.
- 7 (12) Arista bare.
- 8 (9) End of fourth vein strongly curved and the extreme tip somewhat straightened out so that the outer third of the second posterior cell is rather markedly widened; basal band widely separate from anal cross-vein; face without brown band at top. *♀. thyene*, n. sp.
9. (10) End of fourth vein not so strongly curved, outer third of second posterior cell not so abruptly widened.
- 10 (11) Black species; dorsum of thorax shining black with extensive and dense white dust forming a pattern; femora brown and brown bar across base of antennae usually strong; outer width of second posterior cell twice length of upper cross-vein. *♂♀. dryades*, n. sp.
- 11 (10) Brownish species; dorsum of thorax mostly brown with median blackish stripe, dust thin and not appearing as a pattern; femora yellow in male, brownish in female; bar at antennae usually indistinct; first posterior cell wider at end, two and a half times length of upper cross-vein (wing-pattern in male rather diffuse). *♀. umbrina*, n. sp.
- 12 (7) Arista pubescent.
- 13 (14) Scutellum black round sides and behind *unita*, n. sp.
- 14 (13) Scutellum yellow.
- 15 (16) No yellow hypopleural spots *curta*, Mro.
- 16 (15) Yellow hypopleural spots present.
- 17 (18) A single reduced spot *♂. diademata*, Bez.
- 18 (17) A strong double spot.
- 19 (20) Yellow mesopleural stripe rather narrow, as wide as humeri, more or less parallel-sided; basal band on wing separated from anal cross-vein; base of ovipositor one-fourth length of wing *pulchella*, Aust.
- 20 (19) Yellow mesopleural stripe widened; basal band on wing close to anal cross-vein, only hyaline streaks present; base of ovipositor half length of wing *♀ diademata*, Bez.
- 21 (1) Wing-pattern reduced, medial band a tooth.
- 22 (25) Humeri yellow and mesopleural stripe strong and yellow (or white).

- 23 (24) End of marginal band on wing isolated *formosella*, Aust.
 24 (23) Marginal band entire, but much narrowed at end of stigma *tetradactyla*, Mro.
 25 (22) Humeri about concolorous with dorsum of thorax, mesopleural stripe indistinct, the latter region greyish-brown *arguta*, End.

***Perilampus amazuluana*, Mro.**

Munro, 1930, *Bull. Ent. Res.*, 20, 391, Pl. xv, fig. 3.

Only the male type and a damaged paratype of the same sex are known from Zululand.

***Perilampus umbrina*, sp. n.**

A brownish species in which the wing-pattern in the male is diffuse.

Holotype male, Durban, June 1933, W. E. Marriott, taken in bait-trap; allotype female, Durban, 18.5.36. H. K. Munro, netted; paratypes: one ♀, netted, June 1936, W. E. Marriot, and the following bait-trap material — 1♀ August and 1♀ December 1930, 1♂ December 1931, 1♀ June and a pair September 1932 1♂ ♀, 19 ♀♀, June to October 1933, 1♂, 2♀♀, April-May 1936, Benmore, Durban, Marriott.

Length, male, 3.25 mm., of wing, 3.25 mm., female, 5.25 mm., of wing, 4.5. mm. *Head*: proportions of length, height and width, 6 : 9 : 11.5; occiput brownish above, yellow below; frons, about one-third width of head, a little narrowed anteriorly, orange yellow, the vertical plates and ocellar triangle shining yellow, the dot brownish, yellow at lunule, slight black pubescence, two inferior and two superior orbital bristles, the ocellars as strong as the latter; lunule inconspicuous; antennae half length of face, dark yellow, arista bare except slight pubescence at base; face flat, whitish yellow; eye in life in a female reddish with a figure 3 in pale greenish sheen formed by a short, narrow, horizontal bar in the middle and the upper and lower arms widened. *Thorax*: upper part largely brown with white pubescence in the middle of dorsum, black peripherally, in the caught female a median blackish stripe is more apparent; post-scutellum brown; lower parts of thorax yellow in male, brownish in female, in both humeri, broad mesopleural stripe and double hypopleural spot white, scutellum white on disc yellow on sides and behind, more or less triangular, and with slight dark pubescence apically; bristles complete, one mesopleural, the dorsocentrals on line of anterior supra-alars. Wing, male (fig. 1 A) pattern brown and diffuse, female (fig. 1 B) well-defined, black. *Abdomen*, male, base yellow, third segment blackish brown, fourth also, but with

yellow bar on hind half, a median notch reaching the fore edge, fifth blackish brown on sides, on middle yellow, narrow in front, widening to half width of segment on hind edge; female, base yellow, black on sides and front edge, slight silvery bar on hind margin of second segment; third black; fourth also but with silvery bar on hind half, the bar not quite reaching the sides, fifth as in male, sixth mainly yellow. Pubescence black on black (or brown) otherwise yellow, but all black on fifth segment. Male genitalia and venter yellow. Base of ovipositor rather short, stumpy, legging-shaped, 1.0 mm. about as long as segments 3, 4 and 5 together, shining black and black pubescence.

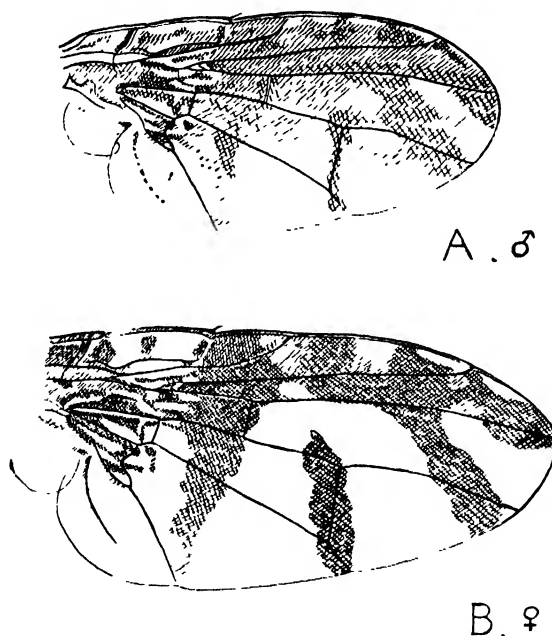


Fig. 1. *Perilampus umbrina*, n. sp. Wing of male, A., of female, B.

***Perilampus thyene*, sp. n.**

Distinct from the other species recorded owing to the dense silvery dust on the dorsum of the thorax.

Holotype ♂, allotype ♀, 1♂, 2♀, paratypes, Uhmlanga Beach, Natal, October 1937, W. E. Marriott (M. 637); 1♂ paratype, Pretoria (Rosslyn), January 1935, H. K. Munro (M. 638); 1♂, paratype Rustenburg, T. P. 26. 4. 32, A. J. Smith, in bait-trap.

♂, length 4.0 mm., wing 4.0 mm., ♀, length 6.0 mm., wing 5.0 mm. *Head*: occiput pale yellow below, darker and with blackish lateral spots above; frons brownish yellow, lighter yellow anteriorly and the vertical plates and ocellar triangle pale shining yellow; antennae brownish yellow like frons, about two-thirds length of face, arista bare; face and rather wide genae lemon yellow; palpi and proboscis yellowish; eyes in life green with a pair of rusty horizontal bars across the middle, these are narrow behind, widening and separating anteriorly, their margins irregular; there is a small pseudo-shadow and the peripheral shadows are strong and dark; in certain lights the eye appears brown with a green bar across the middle and a smaller greenish spot above and below it. *Thorax*: dorsum black, the margins broadly shining and with black pubescence, centrally with thick silvery dust and white pubescence, the dust not forming a pattern; pleura black, lower parts of thorax brown, blacker in female; humeri, mesopleural stripe and double hypopleural spot white, in a fresh specimen the mesopleural stripe yellowish along the suture; scutellum ivory yellow, slightly convex above; post-scutellum shining black; halteres yellow; legs yellow, femora brownish in female; wing-pattern, male, rather diffuse and brownish, basal band evanescent towards hind margin, the fairly distinct cubital obscurely united to marginal and basal, medial and end of marginal largely fused, only a short hyaline streak between; female, pattern practically as in Austen's figure for *pulchella*. Fourth vein strongly arched, the tip almost straight and making a fairly marked angle with the curved portion. *Abdomen* brownish black, brownish yellow at base and at tip; strong silvery bars on second and on hind three fourths of fourth segment, the bars reaching the sides; pubescence black, white on the silver; in female strongly reddish under the silvery dust, fifth segment largely reddish, black on sides and middle of anterior edge, sixth segment reddish. Genitalia and venter reddish brown. Base of ovipositor 1.0 mm., a little shorter than segments 3, 4 and 5 together, shining black with black pubescence, rather flattened in specimens, but probably stout legging-shaped.

Biology. The specimens M. 637 were reared from larvae found in the fruits of *Loranthus* sp. collected at Umhlanga Beach by Marriott in October 1937. The male, M. 638, from Rosslyn, near Pretoria, was reared from a single larva found in a fruit of *Loranthus rubromarginatus*.

Earlier in the season it had been noted that the plant was in full flower, but at the time the fruits were collected in seemed that very few had formed, apart from the fact that many are eaten by birds. Only the one, a very young, larva was found in a partly ripe fruit; it eventually became full-grown, pupated and the fly emerged.

***Perilampus dryades*, sp. n.**

Very like *pulchella*, Aust., but with bare, not pubescent arista.

Holotype ♂, Durban (Benmore) May 1936, H. K. Munro (M. 602); allotype ♀, 3 ♂, 1 ♀, paratypes, Umhlanga Beach, Natal, October 1937, W. E. Marriott (M. 636); 1 ♂, Durban, 28. 6. 36, W. E. Marriott (M. 642) and from bait-traps, Durban (Benmore) W. E. Marriott, 1 ♂, September 1932, 2 ♂, 1 ♀, June 1933, 2 ♀, September 1933, 2 ♂, October 1933.

Length, ♂, 3.75 mm., of wing, 4.0 mm., ♀, 5.0 mm., of wing, 4.5 mm. *Head*: occiput dark yellow, blackish centrally above, blacker in female, the yellow extending on to frons, the anterior third of which white, vertical plates and ocellar triangle shining, the spaces between orange, the ocellar dot brown, and brown spots on each side of middle of frons, a brown bar across base of antennae, touching top of face and including lunule; antennae slightly reddish brown, arista bare, face and genae white. *Thorax* shining brownish black, blacker on dorsum, on centre of which moderate silvery dust, forming a more or less marked pattern more apparent when seen obliquely; the pattern is broadly pear-shaped, narrower in front, wider behind suture, and with a pair of lateral bars along suture partly enclosing a post-sutural black spot; pubescence white on the dust, black on the wide margins; humeri, mesopleural stripe and double hypopleural spot white, scutellum yellow, but largely whitish on disc, and a narrow blackish base, lower part of corners brown, round the hind margin, below, slightly brownish; bristles normal; halteres brown, squamae white; legs brown, tibiae and tarsi paler; wing: pattern similar to that in Austen's figure for *pulchella*, but cubital and medial bars much wider; the last portion of fourth vein gently curved, its tip almost straight. (It may be noted that Major Austen wrote to say that the last portion of the fourth vein in *pulchella* is curved, and not quite straight as shown in the figure). *Abdomen* brownish black, with black pubescence; strong silvery bar on second segment not reaching the lateral margins; but that on hind three-fourths of fourth segment does; pubescence on silver pale; male genitalia and venter brownish; base of ovipositor shining black with black pubescence; 1.4 mm., about as long as pre-abdomen, legging-shaped, narrower and not strongly deflected at end.

Biology. The holotype male (M. 602) was reared from fruits of *Loranthus kraussianus* heavily infested with the larvae of *Perilampus tetradactyla* collected on Benmore (Durban); Mr. Marriott reared one male (M. 642) from a larva in a fruit of *Loranthus quinquerervis* at Durban, and a few specimens (M. 636) from larvae in fruits of *Loranthus* sp. collected at Umhlanga Beach, Natal.

***Perilampus unita*, sp. n.**

On account of the black-margined scutellum, this species is much

like a *Thirhithrum*, but is distinguished by the short point of the anal cell.

Holotype male, Durban, August 1930, allotype female, August 1933, paratypes: 1♂, August 1930; 3♂♂, August 1933, 1♀, September 1932, and 1♀, September 1933, all taken in bait-traps at Benmore, W. E. Marriott; 4♀♀, M. 608, Durban, September 1936, Marriott, bred.

Length, male, 4.0 mm., of wing, 4.0 mm., female, 5.0 mm., of wing, 4.25 mm. *Head*: occiput deep yellow, brownish above, more broadly black in female, the dark yellow extended to middle of frons, vertical plates and ocellar triangle shining and between them, orange yellow, fore half of frons brownish yellow, yellow in female, and a dark spot on each side of lunule; face yellow with brownish bar at top; antennae brown and a brown spot below eyes. Very slight, thin, black pubescence on frons, 2 inferior and 2 superior orbital bristles, ocellars strong; antennae about two-thirds length of face, nearly as long in female, palpi and proboscis yellow, palpi with black setulae. *Thorax* entirely shining black, with more or less of a ferruginous tinge on sutures; pubescence black, white pubescence forming a bar before and a trace of one behind suture; humeri, broad mesopleural stripe, double hypopleural spot and disc of scutellum white, the last broadly black on sides and behind; bristles normal; legs: femora brown to black, otherwise yellowish; halteres brown; squamae white; wing: basal streaks strong, basal band close to anal cross-vein, cubital united, rarely free, medial strong, end of fourth vein strongly arched. *Abdomen* black, first two segments somewhat ferruginous, blacker in female, hind margin of second ferruginous and with silvery dust, third black with trace of dust on hind edge, fourth black with strong silvery bar on hind half, fifth with a weak median ferruginous stripe, in female a round reddish spot on middle of hind edge, the silvery bars not quite reaching sides of abdomen, that on fourth segment in female only half width of the segment; pubescence black, except on silvery bars white and a little on middle of hind edge of third segment; male genitalia black, sternites yellowish; base of ovipositor shining black with black pubescence, robust, stout leggings-shaped, bent downwards apically, 1.25 mm., a little shorter than pre-abdomen, 1.5 mm.

Biology. Four females were reared by Mr. Marriott from larvae in fruit of *Loranthus quinquenervis*, collected on Benmore, Durban, July and September 1936.

***Perilampus curta*, Mro.**

A species from East Africa that has been described elsewhere.

***Perilampus diademata*, Bez.**

Bezzi, 1924, *Ann. S. A. Mus.*, 19, 482, Pl. xii, fig. 28; *Bull. Ent. Res.*, 15, 104 (in tables).

Munro, 1926, *Union S. Afr., Dept. Agric., Ent. Mem.*, 5, 23: 929, *Bull. Ent. Res.*, 20, 394.

It is to be regretted that no female has yet been taken at the type locality, near Pretoria. However, there does not seem any reason to doubt that the pair recorded from Southern Rhodesia in 1929 is this species.

***Perilampus pulchella*, Aust.**

Austen, 1910, *Bull. Ent. Res.*, 1, 72, fig. 1, wing, *Carpophthoromyia*.

Bezzi, 1913, *Bol. Lab. Zool. Portici*, 7, 23, *Ceratitis*; 1918, *Bull. Ent. Res.*, 7, 227, *Carpophthoromyia*; *op. cit.* 920, 10, 233 and 1924, 15, 104, *Perilampus*.

Speiser, *Deutsch. Ent. Zeit.*, 1915, 2, 101, *Carpophthoromyia*.

Specimens collected by Mr. C. C. Gowdey at Entebbe, Uganda, 15. xi. 1909 were received from Mr. H. Hargreaves. These are evidently from the same lot of material as the types in the British Museum. Seven other specimens, also collected by Mr. Gowdey at Entebbe, Nov. 1910, but in rather poor condition, were submitted by Dr. J. Smart of the Department of Entomology of the British Museum.

Apart from Entebbe, only two other localities are recorded for this species, namely Southern Abyssinia (Bezzi 1920) and Kamerun (Speiser, 1915).

It may be noted that in the figure of the wing given by Austen, the end of the fourth vein appears to be almost straight. This is, however, gently curved forward, or even slightly sigmoid, as the late Major Austen wrote to me some years ago.

***Perilampus formosula*, Aust.**

Austen, 1910, *Bull. Ent. Res.*, 1, 74, *Carpophthoromyia*.

Bezzi, 1913, *Bol. Lab. Zool. Portici*, 7, 24, *Ceratitis*; 1918, *Bull. Ent. Res.*, 8, 227, *Carpophthoromyia*; 1920, *op. cit.* 10, 233, and 1924, 15, 104, *Perilampus*.

Enderlein, 1920, *Zool. Jahrb. Syst.*, 43, 354, *Ceratitis*.

Enderlein records a female from Kamerun, but unfortunately gives no notes on the specimen. Apart from this only the male type from Uganda is known.

***Perilampus tetradactyla*, Mro.**

Munro, 1932, *Dept. Agric. S. Afr., Ent. Memoir* No. 8, 40, Pl. III, fig. 12.

The following notes on the colour of the eyes were made from freshly-killed specimens. — In the male they are maroon with extensive purplish reflections, sometimes more or less shining green, or with indistinct rays, usually green, radiating from the

middle of the hind margin; in the female maroon, without diffuse green or purple reflections but with three, irregular, shining green — blue obliquely — bars, one on lower third, one opposite the antennae and one opposite the lower inferior orbital bristle; posteriorly the upper and lower bars curve towards the middle one, but do not quite reach it.

Biology. Larvae were found in large numbers in fruits of *Loranthus kraussianus* growing on a citrus tree on Benmore, Durban, in May and June 1936. Only one larva was in each fruit, feeding among the very sticky latex. To pupate, the larvae burrowed an inch or two into the sandy soil which often adhered to the puparium forming a pseudo-cocoon. In collected material larvae sometimes pupated in the fruits, but the flies (M. 589) found no difficulty in escaping. There was a very slight parasitism by a Braconid. Later in the same locality during August and September 1936, flies (M. 634) were reared by Mr. Marriott from larvae in fruits of *Loranthus quinquennervis*, and again at Umhlanga Beach, to the north of Durban, the obtained flies (M. 635) from larvae in the fruits of another *Loranthus*.

Host-plants collected at Durban were kindly identified by Miss Forbes of the Natal Herbarium.

Perilampus arguta, End.

Enderlein, 1920, *Zool. Jahrb. Syst.*, 43, 354.

The species is described somewhat briefly and it is difficult to discuss its real affinities to other species with reduced wing-pattern. The marginal band appears to be entire; the humeri black, like the dorsum, and, as Enderlein merely says „Mesopleure etwas graubraun” it is not clear whether the stripe along the top of the mesopleura is at all distinct.

Trypeta doris, sp. n.

Syn. *Trypeta péringueyi*, Bez.: Munro, Union S. Afr., Dept. Agric., Ent. Memoir 6, 13, 1929, *Phorellia* and 8, 18, 1935, *Trypeta*.

Very like *T. péringueyi*, Bez. but differs in the yellow abdomen in both sexes, the shorter base of the ovipositor, and the wing-pattern in the male similar to that of the female, although perhaps paler, but not diffuse. As compared with Hendel's description of the genus, the genae are narrower and the epistome rather more prominent; there are two inferior orbitals.

Holotype ♂, allotype ♀, 41 male and 35 female paratypes, M. 313, Pretoria, November 1930; 3 male and 5 female paratypes M. 259, Petronella, near Pretoria, November 1936, and one pair M. 595, Middelburg, Cape, April 1936, H. K. Munro.

Male: length 4.0 mm., of wing, 4.0 mm. Head yellow, an-

tennae light orange yellow. *Thorax*: dorsum and lower part of pleura black with thick yellow dust, a pair of blackish spots at base of scutellum; post-scutellum black with thick yellowish dust, only lower fourth shining black; pubescence pale, bristles black, dorso-centrals on line of anterior supra-alars, four scutellars of about equal length, the basals crossed; legs yellow; wing with M-shaped pattern as in female of *T. péringueyi*, paler but not diffuse, it is yellowish with a blackish tinge, the two inner bars not connected along discal cell. *Abdomen* yellow with black, yellow-shining pubescence, sometimes with a row of brownish sub-median spots; genitalia brown, venter yellow.

Female similar to male; antennae more strongly orange; wing-pattern practically as in *péringueyi* female, blacker than in male. *Abdomen* with stronger and larger row of sub-median spots, but these may be less pronounced or absent. Base of ovipositor as last three segments together, and about three-fourths the relative length it is in *péringueyi*.

Biology. As has been indicated, most of the records published by me under *T. péringueyi* refer to this species. The host-plant is *Senecio crubescens* (Compositae), the larvae living in the flowers. Incidentally, the Braconid parasite, *Opius phorelliae*, Wlksn. was reared from this species at Pretoria and not from *T. péringueyi*.

Scleropithus, n. g.

To a certain extent this genus runs fairly readily to *Trypeta*, Meig. in various tables available (e.g. of Bezzi, Hendel and Shiraki) and it agrees moderately closely with Hendel's description of *Trypeta*.¹⁾ Some characters may, however, be noted. The mesosternites are entirely clothed with long, strong, bristle-hairs; in this regard Enderlein²⁾ says of *Xaniosternum* „Mittelbrust in der vorderen Hälfte ziemlich dicht mit kurzen, dornartigen, senkrecht abstehenden Borsten." Whatever the appearance in *Xaniosternum* actually may be (specimens not being available) it must certainly differ from what is seen here, also it has only two scutellar bristles and the species is long and yellow.

The propleural bristles are much more strongly developed than in *Trypeta*, but are perhaps best regarded as very strong bristle-hairs as they are not quite as definitely bristle-like as in *Acidia*. There are only a couple of setulae on the knot at the base of the third vein; the lower outer angle of the discal cell is acute, about 60°, but not as much as in *Phagocarpus* as the lower cross-vein is not oblique and the upper edge of the discal cell is not

¹⁾ Hendel, in Lindner, Fl. Pal. Reg., 49, Tryp. p. 77, 1927.

²⁾ Enderlein, Zool. Jahrb., 43, Syst., 336, 1920.

shortened; the upper cross-vein is about opposite the middle of the stigma.

The genus may be further characterised thus: *Head* almost as in *Trypeta*, higher than long, the frons somewhat prominent before the eye, the epistome not projecting, and the lower occiput moderate, genae about one-fifth height of eye, a little pubescence on frons which is one-third width of head, three to four inferior orbitals, two superior, ocellars strong, lunule short, antennae shorter than face, arista short pubescent, proboscis short. *Thorax*: dorsocentral bristles behind anterior supra-alars, four scutellars; wing: costal bristles very small, anterior cross-vein a little before middle of discal cell and before end of first vein; lower squama nearly as large as upper. *Abdomen*: base of ovipositor short and broad.

Genotype: *Scleropithus glaphyrochalyps*, the following new species.

***Scleropithus glaphyrochalyps*, n. sp.**

Holotype male, allotype female, 5 male and 7 female paratypes, Durban (Bluff), March-November 1937, W. E. Marriott.

A beautiful and striking species. Male, length, 7.0 mm., of wing, 5.0 mm., female, 7.0 mm., of wing, 5.2 mm. *Head* ochraceous, brownish across lower face and genae; occiput moderate below, above flat with a pair of broad black spots, the median ochraceous part with a silvery sheen; frons deep yellow, mottled blackish behind, brown anteriorly, flat and moderately prominent before eye, about five-eighths wide as long and one-third width of head, slight black pubescence, bristles black, inferior orbitals varying from three to four, sometimes three on one side, four on the other, in one specimen a third superior orbital; lunule short, light brownish, antennae half length of face, yellow, third joint about three times long as wide, its apex with a slight hint of a point above (in one specimen there is, on one antenna, a large, broad, triangular, flat point), arista black, short pubescent; face flat, rather long with deep grooves, cheeks about half width of third antennal joint, genae about twice and one-fifth height of eye, genal bristle and lower clothing black; epistome not projecting, the lower part of head thus rounded; proboscis short and broad; palpi dark yellow with black setulae at end; eye moderately large in profile. *Thorax*: dorsum shining black with rather light silvery dust, stronger between the rather weak median and dorso-central brownish stripes; pubescence black; upper part of humeri black, lower ochraceous; pleura: a strong yellow stripe at top of mesopleura to wing base; black with faint silvery dust, propleura ochraceous, also sutures, and hind parts to some extent.

Scutellum flat on disc, more or less triangular, the apex broadly rounded, yellow, the basal third to two-fifths black; post-scutellum shining black with slight dust (or etching). Chaetotaxy strong, black, supernumerary bristles common; scapulars strong, often a second middle pair behind the first, one humeral, hind notopleural sometimes duplicated on one side, or rarely three, two mesopleurals, at times a third, propleurals a row of strong bristle-hairs, one pteropleural, rarely two, sternopleural present, dorso-centrals about half way between anterior supra-alar and prescutellars, four scutellars of equal length, coxal bristles strong, middle sternite entirely clothed with long, strong bristle-hairs. Legs ochraceous, clothing strong and black, fore femora a little swollen, with two strong rows of fine bristles, middle and hind femora with a row of short bristle-hairs, developing into stronger bristles at end of hind femora, mid tibiae with a strong spur at outer end and an almost complete circle of shorter spurs, mid tibiae slightly, hind, more strongly blackish. Wing: costal bristles small: third vein bare, only two or three setulae on knot, hyaline with narrow, blackish-brown bands, the extreme base yellowish; a band from humeral, cross-vein to point of anal cell, filling inner end of third posterior cell and fading out before reaching wing margin; a band from yellowish stigma straight across outer end of first basal cell, just including upper cross-vein, to hind margin; a straight band from costa over lower cross vein to hind margin along which it may be palely united to previous band with which it forms a V; an apical band joined to the one over the lower cross-vein and reaching almost to fourth vein.

Abdomen shining black, the hind margins of segments at times brownish, covered with faint dust or etching giving the surface almost the appearance of shining steel, the last segment, however (fifth in male, sixth in female) is shining polished black except on the narrow anterior edge; pubescence black; apical bristles strong. Male genitalia shining black, polished. Base of ovipositor short, stumpy, the apex broadly rounded, 1.0 mm., about as long as segments five and six together, light brownish to blackish with black pubescence. Venter black, more or less yellow basally and on hind edges of sternites, except the last.

Puparium. This is very characteristic, the segments are strongly marked and constricted right to the anterior end which is somewhat pointed. The integument, also, is harder than is usual in Trypetid puparia.

Biology. The larvae were found in fruits of *Strychnos henningsii*, collected on the Bluff, at Durban, S. Afr., in the beginning of March 1937 by Mr. W. E. Marriott who may be congratulated on the discovery of this remarkable insect. As they were practically full-grown at the time, the larvae soon pupated, but it is very interesting

to record that the adults did not emerge till the following November. This is an uncommonly long duration of the pupal period for a subtropical Trypetid.

***Oedaspis auriella*, n. sp.**

This is an interesting species of *Oedaspis* and the first recorded from Southern Africa, to be included in the subgenus *Dichoedaspis*, Hendel. It is apparently very like *Oedaspis farinosa*, Hend. a species recorded as "probably from Algeria". Differences that may be noted are: in the new species the third joint of the antennae is about twice as long as wide; the bristles of the head are mostly brownish-black; there are two, not three inferior orbitals; the legs are entirely yellow; the pair of apical bands on the wing are broadly united above.

Holotype male, allotype female, 2 male and 1 female paratypes, Kloof, Natal, April 1935, W. E. Marriott. The larvae and puparia were found in spindle-shaped galls on the thin stems of a *Senecio* sp.

Length, male, 3.25 mm., of wing 3.25 mm. (two small males have a wing-length of 2.5 mm.); female, length 3.6 mm., of wing, 3.5 mm. *Head* yellow; occiput flat above, moderate below, the bristles thickened, yellow; frons a little more than half width of head, flat but very slightly swollen, ocellar dot black, bristles blackish, two inferior and two superior orbitals, the upper of the latter short and yellow, slight pubescence in middle; lunule moderate; antennae a little shorter than face, third joint about twice as long as wide, broadly rounded at end, arista finely pubescent; face with shallow grooves; cheeks about half width of third antennal joint, the genae a little wider than this joint and one-fourth height of eye, genal bristle brownish; eye rather small in profile; proboscis and palpi normal. *Thorax*: dorsum brownish but with extensive, ill-defined, blackish marks across suture, on anterior two-thirds of middle line, and above wings; there is slight golden dust and pale, yellowish, coarse and sparse pubescence, the pleural pubescence pale yellow. On the sides the mesosternites are blackish, the blackness extending upwards to the shining black post-scutellar area, the upper part of the lower portion of the post-scutellum being covered with white dust. Scutellum large, swollen and polished, shining black with four bristles, at the apex are a few (four or five) white, pubescence hairs and before each basal bristle a small, close-set group, corresponding to a similar pair on the hind edge of dorsum; bristles normal, blackish-brown, the pteropleural yellow, no scapulars, one mesopleural, the dorso-centrals on line of anterior supra-alars. Halteres and squamae pale yellow, lower squama narrow. Legs normal, yellow. Wing: a few scattered bristles to upper cross-vein and occasionally one or two

above middle of first posterior cell; the pattern consists of a series of broad blackish bands: a basal band over basal cross-veins and inner ends of first basal, discal and third posterior cells to hind margin; a broad middle band over upper and outer cross-veins to hind margin broadly united to basal as far as third vein and continued to extreme base of wing as far as fourth vein; a broad, isolated, apical band reaching to middle of last section of fourth vein, and divided below by a wide indentation to middle of first posterior cell; outer end of outer costal cell hyaline also a spot on costa near its base; middle band with a few, yellowish, sub-hyaline spots on its upper portion as also the apical band, where they are rather more hyaline. *Abdomen*: Male yellow, the segments on each side with brownish, ill-defined spots of greater or less extent; pubescence brownish, but on lateral margins of abdomen, on hind edge of fourth, and hind half of fifth segment, yellow; venter yellow with yellow pubescence; genitalia reddish. Female, black, the hind edges of segments four and five narrowly yellow, the sixth more widely so, the yellow with a tendency to form a median stripe; sixth segment about two-thirds length of fifth; base of ovipositor shining black with black pubescence, stumpy, short conical, very wide at base where about as wide as length; venter yellow with yellow pubescence.

New species of Phlaeothripidae (Thysanoptera) from South Africa

by

C. JACOT-GUILLARMOD.

In the following paper seven species are described as new; in one case, *Kleothrips*, the genus is an addition to the South African fauna. I am greatly indebted to Professor Faure for allowing me to study and describe his material of *Hoplandrothrips* and to use the notes which he had prepared for the species *Hoplandrothrips arrhenus* sp. n., *H. edentatus* sp. n. and *H. flavidus* sp. n.

All figures are original and were drawn by the author with the help of a projection apparatus.

Key to the South African species of *Hoplandrothrips* Hood.

Females.

- A. Fore femur armed with two teeth near apex, and fore tibia armed with one near middle of inner margin; head longer, 1.66—1.80 times as long as greatest width across cheeks; antennal segment III narrower, 1.90—2.1 times as long as greatest width, IV more than twice as long as greatest width; anterior angular setae of the prothorax very long, 180—273 μ in length.
- B. Antennal segment III less than 1.96 times as long as greatest width; segment IV 2.17—2.30 times as long as greatest width; abdominal tergum I with four (sometimes three) pores; reticulations of tergum I more or less of equal size throughout
arrhenus sp. n.
- BB. Antennal segment III 1.97—2.10 times as long as greatest width; segment IV 1.98—2.17 times as long as greatest width; abdominal tergum I with only two pores; reticulations of tergum I distinctly smaller and relatively narrower in the middle
vansoni sp. n.
- AA. Fore femora and tibiae not armed; head shorter, less than 1.4 times as long as greatest width across cheeks; antennal segment III broader 1.30—1.64 times as long as greatest width; IV broader, 1.48—1.82 times as long as greatest width; anterior angular setae of prothorax shorter, less than 100 μ .

- C. Colour pale yellow; post ocular setae short $46-51_{\mu}$ long; eyes small, less than 0.25 the length of the head; no conspicuous cheek spines
flavidus sp. n.
- CC. Colour at least brownish yellow, usually brown; post-ocular setae longer, more than 70_{μ} long; eyes larger, at least 0.3 the length of the head; at least one conspicuous cheek spine present.
- D. Tube shorter 0.64—0.67 the length of the head and less than twice as long as width at base; prothoracic setae shorter, posterior marginal less than 90_{μ} long; post-ocular seta shorter, less than 80_{μ} ; pores between the two microsetae on tergum II of abdomen usually absent.
landolphiae sp. n.
- DD. Tube longer 0.74—0.89 the length of the head and more than twice as long as width at base; prothoracic setae longer, posterior marginal more than 100_{μ} in length; post-ocular seta longer, over 95_{μ} in length; two pores always present between the two microsetae on tergum II of abdomen
edentatus sp. n.

Males.

- A. Antennal segment III at least 1.7 times as long as greatest width; segment IV slightly more than twice as long as greatest width.
- B. Antenna paler, segments III—V pale yellow, VI paler for at least the basal half; anterior marginal setae of prothorax very short and pointed, distinctly shorter than any other prothoracic seta; at least two distinct, strong cheek spines present ($36-41_{\mu}$ long).
arrhenus sp. n.
- BB. Antennae darker, segments III—V shaded with brown, VI completely brown; anterior marginal setae of prothorax knobbed, only slightly shorter than the posterior marginal setae; three only moderately prominent cheek spines present. *natalensis* (Trybom).
- AA. Antennal segment III broader, about 1.55 times as long as greatest width; IV broader, 1.64—1.77 times as long as greatest width.
- C. Fore femur and tibia unarmed; tube longer, at least 2.1 times as long as width at base and 0.71—0.83

the length of the head; tergum II of abdomen always with two pores between the two microsetae.

edentatus sp. n.

- CC. Fore femur armed with at least one tooth near apex, and tibia usually with a small tooth at basal third on inner margin; tube shorter, 1.75—1.90 times as long as width at base and 0.63—0.68 the length of the head; tergum II usually with no pore between the two microsetae.

landolphiae sp. n.

Hoplandrothrips arrhenus sp. n. (Pl. I, Fig. 1, 2).

Female.

(Macropterous).

Length about 3.1 mm. General colour bright yellow-brown. Head yellowish brown, paler at the extreme base; post-ocular setae and cheek spines distinctly brownish yellow. Prothorax the same as the head but the colour rather blotchy. Pterothorax with sides similar to the head; mesonotum yellowish brown, paler in the middle; metanotum bright yellow. Abdomen paler yellowish brown at the base, the segments darker laterally and gradually becoming darker towards the apex of the abdomen: segment IX more or less the same colour as the head; tube yellowish brown, gradually becoming paler apically. Antennal segment I, basal half pale brownish yellow, the apical half yellowish brown; II yellowish brown at the base, the rest pale brownish yellow; III—V pale yellow, paler at the base, V a shade darker than the preceding two segments; VI pale yellow, shaded with pale brown for the apical third or half; VII and VIII yellowish brown, VII yellowish at base. Fore wing with a very slight brownish-yellow tinge, scale pale brown as well as a short line reaching the second sub-basal seta; hind wing colourless except for a pale brown median line along about the basal half. All trochanters pale brownish yellow, fore pair the darkest; fore femora bright yellow brown, darker along the inner margin; fore tibiae bright yellow, darker at the base, especially along the outer margin; fore tarsis bright yellow, middle and hind femora yellowish brown, paler at the apex; middle and hind tibiae paler than the femora, especially at the base and the apex; tarsi pale brownish yellow. Prothoracic and pterothoracic setae distinctly brownish yellow; abdominal setae yellow except the terminals, which are brown. Ocellar pigment red. Mesodermal pigment appears to be greyish.

Head long, about 1.7—1.9 times as long as its greatest width, broadest at middle, rounded to the eyes and more gently to near base, thence slightly diverging, forming a neck-like constriction which is distinctly narrower than the greatest width across the eyes or about

0.9 the greatest width of the head, set with 3—5 large and 4 to 7 smaller pointed spines, placed on distinct warts, the hindmost the longest about 50 to 66 microns long; entire surface of head practically smooth, occipital and lateral regions with only indistinct cross striations, along posterior margin of eyes distinctly reticulate, genae practically smooth without obvious serrations; vertex weakly produced, not overhanging, and smooth. Post-ocular setae 1.2—1.3 times the length of the eyes, dilated at the apex, situated about half as near to the side of the head as to the eye, their distance apart about twice the interval of the eyes. Eyes closely faceted, about 0.3 the length of the head and about 0.8 as wide as their interval; outer anterior angle weakly curved. Ocelli not equidistant, those of the posterior pair about 0.63 times as distant from each other as from the median ocellus, their posterior margin more or less opposite the middle of the eye. Antennae long, about 1.5 times the length of the head, slender; segment III clavate, 1.90—1.96 times as long as its greatest width, distinctly sinuate on inner surface, pedicel curved outward at the base; IV about 2.2—2.3 times as long as its greatest width, distinctly longer than III; V—VIII more slender than the preceding two segments; V 2.9 times as long as wide; VIII fairly closely united to VII; shape of segments shown in figure; sense cone distribution on inner (outer) surfaces: III 1 (2), IV 2 (2 + 1), V 1 (1 + 1), VI (1 + 1), VII one on dorsum; rather slender especially towards apex of antenna; dorsal outer cone on III 41 microns long. Mouth cone attaining about the middle of the prosternum, labium broadly rounded, slightly surpassed by the acute labrum.

Prothorax about 1.80—1.94 times as broad across the coxae as the median length of the pronotum, which is 0.71—0.77 that of the head; pronotum smooth except the extreme base, which has indistinct striations. All usual setae present; anterior marginals very small and pointed, about 15 microns long; all the others very long, blunt (mere traces of a knob present), epimerals and posterior marginals placed on slight protuberances, their lengths in microns as follows: anterior angulars 250—275, mid laterals 270—310, epimerals 215—225, posterior marginals 210—225, coxals about 100. Pterothorax wider than the prothorax, widest anteriorly, with a projection at each anterior angle; mesonotum very faintly cross-reticulate except posteriorly, i.e. behind the spines, where the reticulations are distinct; the middle reticulations are hardly visible; metanotum smooth on the slightly raised triangle; sides of triangle reticulate and posterior portion of metanotum more feebly so; reticulations at sides longitudinal and the rest more regularly polygonal. Wings slender, widest at base with sides practically straight, fore pair with 17—21 accessory hairs on hind margin; subbasal setae measurements in microns: (a) 35—65, (b) 77—105, (c) 45—60; (a) and (c)

pointed, (b) knobbed or blunt. Fore legs extremely enlarged, coxa reticulate at the base, femur long and broad, armed with a pair of teeth at the apex, tibia short and very stout, armed with a stout curved tooth at the middle on inner margin, inner apical angle produced, provided with a small plate, tarsus with a very large curved tooth about 1.5 times as long as the width of tarsus; middle and hind legs normal to the genus except for a number of stout, dark, curved spines on the upper surface of the femora.

Abdomen distinctly narrower than the fore portion of the pterothorax, widest at segment II, segments distinctly polygonally reticulate laterally and at anterior margin, indistinctly so at the middle and smooth along the posterior margin; tergum I with four pores (sometimes three), distinctly reticulate, the reticulations more or less equal in size and shape throughout, indistinctly smaller in the middle; pores on terga III—VI 13—61 microns apart. Tube reticulate ventrally at base, about 0.65—0.68 the length of the head and about 2.5 times as long as width at base (which is about twice that at the apex), sides nearly straight; lateral setae on segment IX stout, usually slightly expanded, the longest seta, 230—250 microns long, distinctly shorter than tube; terminal setae 200—215 microns long, shorter than the longest on IX.

Measurements of female (holotype) in mm. — Length about 3.07; head length 0.430, width across eyes 0.240, greatest width across cheeks 0.260, least width at base 0.240; eye, length 0.110, width 0.075, interval 0.090; ocelli, diameter of median 0.031, of posterior 0.031, interval between posterior pair 0.035, distance from median to posterior 0.030; post-ocular setae, length 0.165, distance apart 0.185; longest cheek spine, length 0.060; prothorax, median dorsal length 0.330, width (including the coxae) 0.610; prothoracic setae lengths, anterior angular 0.265, mid lateral 0.310, epimeral 0.215, posterior marginal 0.210, coxal 0.100; pterothorax greatest width 0.630; fore wing, length 1.500, greatest width at base 0.140, least width at middle 0.120; subbasal setae lengths, (a) 0.035, (b) 0.015, (c) 0.045; abdomen, greatest width (segment II) 0.565; tube, length 0.290, greatest width at base 0.115, least width at apex 0.055; longest seta on segment IX, length 0.230; longest terminal seta, length 0.210.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	61	56	110	117	110	87	74	43
Width in microns	64	46	56	54	38	33	26	18

Total length of antenna 0.658 mm.

Male.

(Macropterous).

Length about 2.8 mm. — In colour very similar to the female except that it is generally duller, and the forelegs are darker,

especially the tibiae which are similar to those of the middle and hind legs; all tarsi pale brownish yellow; otherwise like the female. Structurally there is great similarity between the two sexes; the differences being: male much smaller, forelegs not enlarged to such a great extent; fore femora armed with only the outer tooth, the inner represented by a thickening of the integument; fore tibiae relatively longer and narrower, the tooth nearer to the base and the anterior projection weaker; fore tarsal tooth much smaller, not quite as long as the width of the tarsus. Coxal setae shorter and pointed; all prothoracic setae relatively shorter. Antennal segment III broader, 1.7 times as long as its greatest width. Head relatively shorter 1.52 times as long as greatest width; ocelli more or less equidistant. Prothorax distinctly shorter, 0.61 the length of the head and including the coxae 2.13 times as wide as long. Tube longer, 0.74 the length of the head and 2.72 times as long as width at the base; terminal setae longer, subequal to the longest seta on segment IX. Fewer accessory hairs on hind margin of forewing, 9—13 in number.

Measurements of male (allotype) in mm. — Length about 2.83; head, length 0.330, width across eyes 0.195, greatest width across cheeks 0.210, least width at base 0.180; eye, length 0.107, width 0.061, interval 0.077; ocelli, diameter of posterior 0.018, of median 0.023, distance from median to posterior pair 0.033, interval between posterior pair 0.031; post-ocular setae, length 0.115, distance apart 0.160; prothorax, median dorsal length 0.200, width (including the coxae) 0.425; prothoracic setae lengths, anterior angular 0.145, mid-lateral 0.155—0.170, epimeral 0.140, posterior marginal 0.140, coxal 0.045; pterothorax, greatest width 0.440; fore wing, length 1.012, greatest width at base 0.110, least width at middle 0.085; subbasal setae, lengths (a) 0.038, (b) 0.084, (c) 0.054; tube, length 0.245, greatest width at base 0.090, least width at apex 0.043; longest seta on segment IX, length 0.195; longest terminal seta, length 0.195.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	51	51	82	87	77	66	59	36
Width in microns	51	38	49	43	33	31	26	15

Total length of antenna . . . 0.509 mm.

Described from 31 females and 7 males, all macropterous, collected 17—VII—1930 by Professor J. C. Faure, in curled leaves of *Syzygium cordatum* Hochst. (= *Eugenia cordatu* Laws.) at Contra Costa, Chai Chai, Portuguese East Africa.

The only other known species of *Hoplandrothrips* in which the female has armed forelegs are *gynandrus* Hood and *virago* Hood from North America and *vansoni* sp. n. from the Transvaal; the differences between the last named and present species are fully discussed under that species; from the first two it may easily be distinguished by the forelegs of the female being much more

enlarged (reminding one of *Arrhenothrips*), by the much longer prothoracic setae, the paler antennae, and the very weakly developed reticulation, especially on the head. With regard to the female, the present species may be separated from all other species in which the female is known by the greatly enlarged forelegs and armed fore femora and tibiae and the very long prothoracic setae; the male may be separated from all known African species except *natalensis* (Trybom) by the presence of only one tooth on the fore femur and in addition it may be separated from *hystrix* Bagnall, from Sierra Leone, which appears to be closely related to it by the shorter prothoracic setae, fewer cheek spines and the fewer accessory hairs on hind margin of the fore wing (9—13 compared with 18—21). From *natalensis* (Trybom), which also has only one tooth on the fore femur, it may easily be separated by the paler and differently shaped antenna, the longer head, the much longer and differently shaped prothoracic setae (except the anterior marginals) and the stronger cheek spines. In addition the present species may be separated from the other South African species by the characters given in the key. I am much indebted to Dr. Hood and Dr. Priesner, who compared this species and made suggestions to Professor Faure.

Hoplandrothrips vansonii sp. n. (Pl. 1, Fig. 3, 4).

Female.

(Macropterous).

Length about 3.8 mm. — General colour bright yellow brown to golden brown. Head yellowish brown, paler at the posterior margin of the eyes and between the eyes, and the basal fifth bright brownish yellow, gradually merging into the general colour of the head. Prothorax more brown than the head except in the middle where it is of a bright brownish yellow. Pterothorax bright brownish yellow, more yellow than the head, membranous portions bright yellow. Abdominal segments I—VII the same colour as the sclerotised portions of the pterothorax, darker laterally; VIII the same as the head and IX the same as the darker portion of the prothorax; tube, at the base, the same as IX, gradually becoming paler towards the apex. All setae distinctly shaded with brownish yellow, those on the abdomen (except the terminals) paler than the rest. Fore wing slightly tinged with pale yellowish brown, scale and small patches at the base pale brown; hind wing the same as the fore wing, with a pale brown line (darker in the middle of the wing) extending slightly past the middle of the wing, fore margin darker than the rest of the wing, especially near the middle. Fore legs coloured as follows: coxae and femora brownish yellow, about the same as the base of the head, outer basal angle of femur more yellow, apex

merging to bright yellow; tibiae and tarsi bright yellow, the former, except on the outer basal angle, hardly tinged with brown at the base. Middle and hind legs similar, femora dark yellow brown, paler at the base and the apex; tibiae yellowish brown, paler at each extremity, distinctly paler than the femora; tarsi and trochanters brownish yellow. Antennal segment I yellowish brown, paler than the head; II brownish yellow, the brown more pronounced on the inner margin (I and II may be more or less similar and just a shade darker than III); III—V clear yellow, paler at the base, V slightly darker than the preceding two; VI yellow tinged with brown on the apical half; VII and VIII brown, the former yellowish at the base. Ocellar pigment red. Mesodermal pigment not visible in any of the specimens.

Head long, 1.7—1.8 times as long as its greatest width, broadest at the middle, rounded to eyes and more gently to near the base, thence slightly diverging, forming a neck-like constriction which is distinctly narrower than the width across the eyes or about 0.89—0.94 the greatest width of the head, cheeks set with about 4 large and 6 smaller pointed spines placed on distinct warts, the hindmost spine the longest (66—74 microns); entire surface of the head practically smooth, occipital and lateral regions only indistinctly reticulate (more distinct at the base of the head); along the posterior margin of the eyes distinctly reticulate; genae practically smooth, not showing obvious serrations; vertex weakly produced, and not overhanging, smooth. Post-ocular setae 1.06—1.25 times the length of the eye, dilated at the apex, situated about half as near to the side of the head as to the eye, distance apart about twice the interval of the eyes. Eyes closely faceted, about 0.3 times the length of the head and about 0.8 times as wide as their interval; outer margin rather strongly curved with a sharply curved anterior angle. Ocelli practically equidistant, posterior margin of posterior pair about in line with the middle of the eyes. Antennae about 1.6 times the length of the head, slender; segment III clavate, 1.97—2.1 times as long as its greatest width, distinctly sinuate on inner surface, pedicle curved outward at base; IV 1.98—2.17 times as long as its greatest width, distinctly longer than III; V 2.37—2.63 times as long as wide; VIII fairly closely united to VII; shape of the segments is shown in figure; sense cone distribution on inner (outer) surfaces: III 1 (2), IV 2 (2 + 1), V 1 (1 + 1), VI 1 (1 + 1), VII usual cone on dorsum; dorsal outer cone on III 43 microns long, those on VI much smaller than the rest. Mouth cone attaining about the middle of the prosternum, labium broadly rounded and slightly surpassed by the acute labrum.

Prothorax about 1.78—1.98 times as broad across the coxae as the median dorsal length of the pronotum which is 0.71—0.79 that of the head; pronotum smooth, except the extreme base which has

indistinct striations. All usual setae present, anterior marginals very much shorter, and pointed, the rest very long and slightly dilated at the tip (the coxals are also pointed), the epimerals and the posterior marginals placed on slight protuberances; their lengths in microns as follows: anterior marginals 25—60, anterior angulars 180—275, mid laterals 225—310, epimerals 170—255, posterior marginals 190—250, coxals 80—120 (the shorter belong to a much smaller specimen). Pterothorax at the anterior angles wider than the prothorax and narrowing towards the base, with a projection at each anterior angle; mesonotum faintly but distinctly cross-reticulate except in the middle and at the lateral angles where it is smooth; posterior portion, i.e. posterior to the spines, has deeper reticulations; metanotum only faintly reticulate, especially on the raised triangle which is practically smooth, the lateral reticulations longitudinal, the rest regularly polygonal. Wings slender, widest at the base, with the sides more or less straight (there is a slight indication of narrowing at the middle); fore pair with 20—23 accessory hairs on the hind margin; subbasal setae pointed, measuring in microns: (a) 15—65, (b) 75—115, (c) 35—60. Fore legs extremely enlarged; fore coxa reticulate at the base, femur very stout and long, with a pair of stout teeth at the apex; tibia short and very stout with a stout curved tooth at about the middle on the inner margin, inner apex produced, with a small plate; fore tarsus with a very large curved tooth about 1.5 times as long as the width of the tarsus. Middle and hind legs normal to the genus except for a number of stout, dark curved spines on the upper surface of each femur.

Abdomen distinctly narrower than the fore portion of the pterothorax, widest at segment II, segments distinctly polygonally reticulate laterally and at anterior margin, indistinctly at middle and smooth at posterior margin; tergum I with two pores, distinctly reticulate, the reticulations polygonal outwardly, becoming distinctly smaller and relatively narrower at the middle (giving the centre a raised appearance). Pores on terga III—VI 41—66 microns apart. Tube reticulate ventrally at the base, about 0.68—0.76 times the length of the head and about 2.54—2.65 as long as the width at the base (which is a little more than twice that at the apex), sides nearly straight. Lateral setae weakly expanded at the apex, except the terminals and those on IX which are pointed; dorsal pair on IX slightly expanded at tip; longest seta on IX distinctly shorter than tube, the dorsal pair usually slightly longer than the laterals, about 230—250 microns long; terminal setae shorter than those on IX, about 210—245 microns long.

Measurements of female (holotype) in mm. — Length about 3.76; head, length 0.420, width across eyes 0.240, greatest width across cheeks 0.250, least width at base 0.225; eyes, length 0.130,

width 0.075, interval 0.095; ocelli, diameter of median 0.033, of posterior 0.028, interval between posterior pair 0.033, distance from median to posterior 0.033; post-ocular setae, length 0.155, distance apart 0.180; longest cheek spine, length 0.066; prothorax, median dorsal length 0.320, width (including the coxae) 0.620; prothoracic setae, lengths, anterior marginal 0.030, anterior angular 0.275 mid-lateral 0.305, epimeral 0.220, posterior marginal 0.235, coxal 0.100; pterothorax, greatest width 0.630; fore wing, length 1.650, greatest width at base 0.135, least width at middle 0.110; subbasal setae, lengths (a) 0.065, (b) 0.115, (c) 0.065; abdomen, greatest width (segment II) 0.530; tube, length 0.320, greatest width at base 0.120, least width at apex 0.050; longest seta on segment IX, length 0.245; longest terminal seta, length 0.225.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	66	59	110	120	102	87	77	49
Width in microns	61	49	56	59	43	36	28	18
Total length of antenna	0.670 mm.							

Described from 7 females, all macropterous, collected by G. van Son, April 1932, on what probably was *Cryptocarya Woodii* at Marieps Mountain (alt. 5500 feet), Transvaal.

I take pleasure in naming this new species after the collector, Mr. G. van Son of the Tranvaal Museum.

Although the present species is very similar to *Hoplandrothrips arrhenus* sp. n. the two species show very constant differences, the more important being: (1) the differently shaped eyes, more prominent and with a more pronounced anterior angle in the present species; (2) antennal segments differently shaped, III 1.97—2.10 times as long as greatest width in *vansoni* compared with never more than 1.96 in *arrhenus*, IV never more than 2.17 times as wide as long in the present species as compared with 2.17—2.32 in *arrhenus*, V much wider in the present form (2.37—2.63 times as long as wide, compared with about 2.9); (3) Tergum I of the abdomen with only two pores compared with four (sometimes three) in *arrhenus* and the reticulations more or less equal throughout in the former species whereas they are much smaller and differently shaped in the middle of the tergum in the present form; (4) the head appears to be relatively shorter in the present form although there is overlapping between the two; (5) in *vansoni* the coxal setae are always pointed as well as all the subbasal setae of the fore wing, whereas in *arrhenus* the coxals are slightly knobbed and at least one of the subbasal setae is expanded at the tip; there is also a slight difference in the colour. From all other known species of *Hoplandrothrips* the present form may be separated by the characters mentioned for *arrhenus*.

Hoplandrothrips flavidus sp. n. (Textfig. 1, a and b.)*Female.*

(Macropterous).

Length about 1.2 mm. General colour pale yellow; head pale yellow, slightly darker at the base of the antennae, between the eyes. Prothorax a shade darker yellow than the head, this probably due to the presence of the mouth-cone and the fore coxae below it. Pterothorax slightly darker than the prothorax, especially at the sides; hinder portion paler, the same colour as the abdomen which is pale yellow with segments VIII and IX darker, more or less like the major portion of the pterothorax; the tube of a deeper yellow on the basal half, the apical half shaded with grey. All the legs the same colour as the head; each tarsus, however, with a dark patch near the apex on the inner side. Antennae with segments I—III pale yellow, III a shade darker towards the apex; IV pale yellow at the extreme base (on the narrow necklike portion) the rest yellow tinged with brown; V—VIII uniformly yellowish-brown. Wings with a faint tinge of yellowish-brown throughout. All setae colourless or slightly yellowish except the terminals on the tube which are shaded with brown at the base. Ocellar pigmentation red. Mesodermal pigmentation not evident except in small patches in the abdomen where it is red.



Text-fig. 1. *Hoplandrothrips flavidus* sp. n. female holotype (a) head, prothorax, and fore legs; (b) left antenna.

Head about 1.09 times as long as greatest width, broadest just behind the eyes, narrowed basally; cheeks subparallel in the distal half, except where they curve abruptly to the eyes; width across the eyes somewhat less than 0.9 times the greatest width of the head and somewhat less than the least subbasal width; surface of head smooth, with no reticulations; vertex not noticeably produced or overhanging. Post-ocular setae 46—51 microns long and 112—122 microns apart at the bases, strongly dilated at the apex. Eyes rounded, finely faceted, not quite one-quarter the length of the head, and dorsally about 0.75 times as wide as their interval. Ocelli close together, placed on a slight prominence, the median one within a line tangent to the fore margin of the eyes. Antennae about 1.9 times as long as the head, segments III and IV broad, V—VIII relatively narrow; III about 1.3 times as long as wide and IV 1.48; chaetotaxy and shape of the segments shown in figure; sense cones on inner (outer) surfaces of segments as follows: III 1 (2), IV 2 (2), V 1 (1), VI 1 (1 + 1), VII with one on dorsum; those on segments III, IV and the inner one of V large and thick, the rest relatively weaker. Mouth cone slender, reaching the base of the prosternum; the labrum acute while the labium is rounded.

Prothorax along the median dorsal line about 0.67 as long as the head and (including the coxae) about twice as wide as long; surface smooth; the epimeron not fused with the pronotum. All the major setae present, colourless, with broadly dilated tips; their lengths in the holotype in microns as follows: anterior marginals 33, anterior angulars 41, mid-laterals 41, epimerals 51, posterior marginals 43, coxals 43. Fore tarsus with a distinct, curved tooth medially on the inner surface; fore-femora and tibiae unarmed. Pterothorax less than 1.1 times as wide as the prothorax including the coxae. Wings slightly but distinctly narrowed in the middle, fore pair with 4—6 accessory setae; all three subbasal setae similar in shape to the prothoracic setae, their lengths in microns as follows: (a) 38—41, (b) 44—47, (c) 38—41.

Abdomen widest at about segments 5—7 where it is only slightly wider than the pterothorax. All segments short; I and II with one pair and III—VI with two pairs of setae dilated at the tip; VII and VIII each with one pair of pointed and one pair of dilated setae; the rest of the segments with pointed setae. Sterna II to VIII each with ten to twelve accessory setae. Tube about 0.7 times the length of the head and about 1.97 times as wide at the base as at the apex, the sides almost perfectly straight. Longest setae on segment IX, 128—130 microns long and the terminals on the tube 105—107 microns.

Measurements of female (holotype) in mm. Length about 1.2; head, length 0.175, greatest width (across cheeks) 0.160, width

across eyes 0.137, least width near base 0.150; eyes, length 0.019, width 0.042, interval 0.056; post-ocular setae, length 0.051, distance apart 0.112, distance from base of eye 0.018, distance from side of head 0.026—0.020; prothorax, median dorsal length 0.117, width (including the coxae) 0.235; pterothorax, greatest width 0.250; fore wing, length 0.620, greatest basal width 0.061, width at middle 0.049; abdomen, greatest width (across segment VII) 0.255; tube, length 0.125, width at base 0.061, at apex 0.031.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	36	38	43	49	43	49	46	33
Width in microns	36	28	33	33	25	22	20	11

Total length of the antenna 0.337 mm.

Described from 3 females, all macropterous, collected at Pretoria, Transvaal, 7.3.1920., among fallen leaves (*Professor J. C. Faure*).

The pale yellow colour is quite distinctive and will enable one to separate it from all other members of the genus *Hoplandrothrips*. It may, however, safely be compared with *Phlaeothrips pocillus* Hood from Tanganyika with which it agrees in a number of points but differs in the smaller size, colourless setae, broader antennal segments III and IV, and the head being smooth. The present species has been placed with some reserve in the genus *Hoplandrothrips* as the male is not known yet. As pointed out by Dr. Priesner, who was kind enough to compare the specimens, it may just as well be placed in *Pygmaeothrips* although it has a much shorter head: however, he agrees that for the present it is well placed in *Hoplandrothrips* until the male is discovered.

Hoplandrothrips edentatus sp. n. (Pl. II, Fig. 7, 8)

Male.

(Macropterous).

Length about 2.1 mm. General colour brown washed with yellow. Head brown, the yellowish tinge most pronounced at the extreme base, dorsally, and round the inner margins of the eyes. Prothorax more yellow than the head except the anterior angles, anterior to the long setae, which are the same colour as the head. Pterothorax similar in colour to the prothorax except the membranous parts which are almost clear yellow. Abdomen similar to the prothorax, with the lateral portions of all segments and the whole of segment IX (except the extreme base) darker. Basal third of tube darker. All trochanters greyish yellow; all femora the same brown as the head; fore tibiae brownish yellow, darker in the middle; middle and

hind tibiae similar to the head in colour with the apices paler. Fore wing slightly tinged with brown, scale pale brown; hind wing practically colourless. Antennal segments I and II yellowish brown, II tending to be paler at the apex; III yellowish on the narrowed portion, yellowish brown on the rest (palest of segments); IV and V yellowish brown with paler bases; VI—VIII yellowish brown, slightly paler than the head. Ocellar pigment red. Mesodermal pigment not evenly distributed, where present red.

Head about 1.03—1.20 times as long as the greatest width, broadest behind the eyes (sometimes width across eyes the same as that behind eyes), slightly narrowed basally; cheeks subparallel, rounded to eyes and more gently to base, thence slightly diverging thus forming a neck-like constriction which is about 0.9 times the greatest width across the cheeks; cheeks set with about three pairs of yellowish spines, the hind-most the longest (13—23 microns). The entire dorsal and lateral surfaces of the head reticulate, faintly in occipital region, more strongly at sides, so that the cheeks are minutely serrate in profile; vertex slightly produced and overhanging, not reticulate. Post-ocular setae pale yellowish brown, about 1.06 times as long as eye, dilated at tip; their distance from the sides of the head about 1.6 that from the eye and their interval more than twice that of the eyes. Eyes about 0.4 the length of the head and about 0.9 times as wide as their interval. Ocelli almost equidistant, those of the posterior pair with their posterior margins slightly in front of the centre of the eyes. Antennae nearly 1.9 times the length of the head, rather broad; segment III about 1.61 times as long as its greatest width; IV usually the longest (in one case equal to and in two cases shorter than III); the shapes of the respective segments are shown in the figure; sense cones distributed on inner (outer) surfaces as follows: III 1 (2), IV 2 (2), V 1 (1 + 1), VI 1 (1 + 1), VII one on dorsum; the inner cone on III, broad and about 2.3 microns long; the dorsal pair on IV larger than the ventral pair; those on V—VII smaller than those on the preceding segments; a rudimentary cone is sometimes present on IV, the formula then being IV 2 (2 + 1); the outer cone on VI very much smaller than the rest. Mouth cone attaining the middle of the prosternum, labium broadly rounded, slightly surpassed by the acute labrum.

Prothorax about 2.8 times as broad across the coxae as the median dorsal length which is 0.58—0.65 that of the head. Pronotum smooth except for a few inconspicuous reticulations at the sides; all usual setae present, yellowish and expanded at the tip except the anterior marginals which may be much shorter and pointed (in some specimens these setae are long and expanded on one side and short and pointed on the other), their measurements in microns are: anterior marginals 20—56, anterior angulars 61—82,

mid-laterals 66—89, epimerals 84—95, posterior marginals 89—107, coxals 51—64. Pterothorax wider than the prothorax including the coxae, widest anteriorly and narrowed posteriorly; mesonotum cross-reticulate and metanotum longitudinally reticulate. Wings about 9—10 times as long as greatest subbasal width, distinctly broader in basal half than in apical half; slightly narrowed in the middle; 5—9 accessory hairs (usually 7) on hind margin of fore wing; half of the specimens with three subbasal setae, the other half with four; (a) and (b) similar to the prothoracic setae, (c) and (d) either expanded at the tip or pointed; their measurements in microns are: (a) 61—72, (b) 66—79, (c) 49—72, (d) 43—66. Fore legs moderately enlarged, *fore femora and tibiae unarmed*; fore tarsus armed with a stout tooth; middle and hind legs normal.

Abdomen as wide as or slightly narrower than the pterothorax, widest at segment II; pores on terga III—VI 20—41 microns apart, usually about 28 microns. Tube 0.71—0.83 the length of the head and about 2.1 times as wide at base as at apex; sides slightly convex in the middle. Both pairs of lateral setae on segments II—VIII expanded, segment IX with laterals pointed and the dorsals slightly expanded at the tip; longest seta on IX about subequal to the tube. All setae yellowish, the terminals shaded with brown at the base. Accessory bristles present on the sterna.

Measurements of male (Holotype) in mm. — Length about 2.06; head, length 0.210, width across eyes 0.185, greatest width across cheeks 0.185, least width at base 0.166; eye, length 0.085, width about 0.060, interval about 0.065; post-ocular setae, length 0.092, distance apart 0.135; ocelli, diameter of median 0.026, of posterior 0.020, interval between posterior pair 0.028, distance from median to posterior 0.023; longest cheek spine, length 0.018; prothorax, median dorsal length 0.123, width (including the coxae) 0.345; prothoracic setae, anterior marginal 0.041, anterior angular 0.064, mid lateral 0.066, epimeral 0.087, posterior marginal 0.089, coxal 0.051; pterothorax, greatest width 0.380; fore wing, length 0.840, greatest basal width 0.085, least width at middle 0.070; subbasal setae, lengths, (a) 0.064, (b) 0.066—0.069, (c) 0.049, (d) 0.043—0.054; abdomen, greatest width (segment II) 0.370; tube length 0.170, width at base 0.079, at apex 0.039; longest seta on abdominal segment IX, length 0.150, longest terminal seta, length 0.135.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	36	16	59	61	51	52	15	36
Width in microns	38	33	36	36	31	28	26	15

Total length of antenna 0.391 mm.

Female.

(Macropterous).

Length about 2.3 mm. — General colour similar to that of the male. Structurally the female is also essentially like the male, excepting that it is slightly larger; the tube is longer ventrally than dorsally; in all cases the anterior marginal setae of the prothorax are expanded at the tip; only three subbasal setae and never four are present on the fore wing, and the accessory hairs on the hind margin of the fore wing are usually slightly more numerous 6—10 (usually 8).

Measurements of female (allotype) in mm. — Length about 2.30; head, length 0.230, width across eyes, 0.215, greatest width across cheeks 0.220, least width at base 0.205; eye, length 0.096, width about 0.072, interval about 0.077; post-ocular setae, length 0.105, distance apart 0.150; ocelli, diameter of median 0.028, of posterior 0.026, interval between posterior pair 0.033, distance from median to posterior 0.036; longest cheek spine, length 0.013; prothorax, median dorsal length 0.128, width (including coxae) 0.385; prothoracic setae, anterior marginal 0.061, anterior angular 0.077—0.087, mid lateral 0.079—0.082, epimeral 0.100, posterior marginal 0.107, coxal 0.054; pterothorax, greatest width 0.415; fore wing length 0.860, greatest basal width 0.097, least width at middle 0.074; subbasal setae lengths, (a) 0.074, (b) 0.087, (c) 0.084; abdomen, greatest width (segment II) 0.400; tube, dorsal length 0.170, ventral length 0.190, width at base 0.080, at apex 0.046; longest seta on abdominal segment IX, length 0.165, longest terminal seta, length 0.150.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	38	49	69	69	56	59	54	36
Width in microns	43	31	38	43	33	29	28	15

Total length of antenna 0.430 mm.

Described from 12 males and 12 females, all macropterous, collected by C. C. Kent at Durban, Natal (9.1.1924), on *Vangueria tomentosa* Hochst.

The present species may be separated from all known African *Hoplandrothrips* by the unarmed fore femora and tibiae in the male. In addition, its short head (less than 1.2 times as long as wide) separates it from all African species except *coffiae* Bagnall and *flavidus* sp. n.; from the latter it may easily be distinguished by its colour, shape of head and shape and length of the post-ocular and pronotal setae; from the former it may be separated by the setae on abdominal segment IX being distinctly longer than the terminals, by the shape of the antenna and by the

longer pronotal setae. From *landolphiae* sp. n. it may in addition to the characters given in the key, be separated by the absence of projections on the ventral surface of antennal segments V and VI.

***Hoplandrothrips landolphiae* sp. n. (Pl. II, Fig. 5, 6.)**

Female

(Macropterous).

Length about 2.0 mm. — General colour yellowish brown. Head yellow-brown, darker at the sides. Prothorax and pterothorax more yellow than the head; membranous parts of the pterothorax clear yellow. The base of the abdomen the same colour as the prothorax, gradually darkening towards the apex so that segment IX is the same colour as the head; each segment darker laterally; tube the same shade as the head at the extreme base and the apical half, the rest dark brown. Wings slightly tinged with yellow; the scale and the extreme base of the fore wing pale brown; hind wing with a pale brown longitudinal line extending for about the basal half of the wing; apical half of the hind margin of the hind wing pale brown. Antennal segments I and II yellowish brown, paler than the head, II paler for its apical half and darker on the inner margin; III pale yellow, with a slight tinge of brown towards the apex; IV and V pale brownish yellow, IV paler at basal half and V at about its basal third; VI yellowish brown, paler for about its basal third; VII and VIII the same shade as the head. Fore legs slightly paler than the head, the tibia paler towards the apex, the tarsus pale brownish yellow; middle and hind legs darker than the fore legs, the tibiae paler at the extreme apex; tarsi slightly darker than the fore pair. Head setae and terminal setae of the tube distinctly yellowish brown, prothoracic brownish yellow, and the rest of a yellowish colour. Ocellar pigment red; mesodermal pigment red, prominent especially in the prothorax, pterothorax and the sides of the abdomen.

Head short, 1.12—1.20 times as long as its greatest width, broadest just behind the eyes, cheeks more or less straight, abruptly rounded to the eyes and slightly but evenly converging to the base of the head, where the width is 0.86-0.91 that of the greatest width across the cheeks; constriction at the base practically absent; one prominent, pointed, cheek spine placed at about the basal third 13-20 microns in length, other cheek spines rudimentary; dorsal and lateral surfaces of head faintly reticulate, more distinctly so at the base, the sides and especially at the posterior margin of the eyes, occipital region practically smooth; genae minutely serrate in profile; vertex distinctly produced and overhanging, more finely reticulate than the rest of the head; post-ocular setae about 0.30-0.36 times the length

of the head and about equal to the length of the eyes, dilated at apex, situated distinctly nearer to the eye than to the side of the head, their interval twice that of the eyes. Eyes about 0.3 times as long as the head and about 0.8 as wide as their interval. Ocelli not equidistant, those of the posterior pair about 0.7 times as distant from the anterior ocellus as from each other, their posterior margins in advance of the middle of the eyes. Antennae about 1.8 times as long as the head, the segments rather broad; III 1.44-1.56 times as long as greatest width; IV 1.74-1.82 times as long as greatest width, and V 1.77-1.90 as long as greatest width; V and VI produced ventrally at apex, more pronounced in V; sense cones on inner (outer) surfaces: III 1 (2), IV 2 (2+1), V 1 (1+1), VI 1 (1+1), VII one on dorsum; outer dorsal cone on III 31-33 microns long. Mouth cone not attaining the posterior margin of the prosternum, labium broadly rounded and slightly surpassed by the acute labrum.

Prothorax about 2.36-2.50 times as broad across the coxae as the median length of the pronotum, which is 0.54-0.63 that of the head; pronotum smooth except its extreme base which is faintly reticulate; all usual setae present, expanded at apex, including the short anterior marginals which are placed very close to the anterior margin of the pronotum; measurements of these setae in microns as follows: anterior marginals 31-38, anterior angulars 61-64, mid-laterals about 46, epimerals about 54-66, posterior marginals 74-82, coxals 51-61. Pterothorax slightly wider than the prothorax across the coxae, fairly abruptly constricted posteriorly to form a distinct narrowing at segment I of the abdomen; mesonotum with the usual cross-reticulations, smooth in the middle; the whole metanotal triangle faintly reticulate, the reticulations regularly polygonal for about the anterior third, more longitudinal for the rest. Wings narrower at apex and in addition distinctly narrowed near the middle; fore wing with 5-8 (usually 7 or 8) accessory hairs on its hind margin; subbasal setae, lengths: (a) 54-66, (b) 61-69, (c) 46-77, (a) and (b) always expanded at the tip while (c) may be expanded or pointed. Fore legs enlarged, femur and tibia unarmed, tarsus armed with a strong tooth; middle and hind legs normal.

Abdomen broader than the pterothorax segments II-V of equal width, thence narrowing to the tube. Tergum I with only 2 pores; evenly reticulate with equal-sided polygonal cells throughout; tergum II usually with no pores between the two microsetae, sometimes with one and rarely with two; tergum III usually with only one pore between the two microsetae; when two are present then they are 20-23 microns apart; each segment faintly reticulate, more distinctly so laterally; tergum IX 74-91 microns long. Tube 0.64-0.67 times as long as the head; about 1.90-1.96 times as long as its greatest basal width which is about twice the apical width;

sides nearly straight. Lateral abdominal setae rather short and knobbed, the longest seta on IX 110—125 microns long; terminal setae shorter than the tube, 120—140 microns long, but longer than those on segment IX.

Measurements of female (holotype) in mm. — Length 2.00; head length 0.220, width across eyes 0.181, greatest width across cheeks 0.196, least width at base 0.173; eye, length 0.074, width 0.056, interval 0.069; ocelli, diameter of median 0.023, of posterior 0.018, distance from median to posterior 0.018, interval of posterior pair 0.028; post-ocular setae, length 0.074—0.079, distance apart 0.138; longest cheek spine, length 0.020; prothorax, median dorsal length 0.138, width (including the coxae) 0.354; prothoracic setae lengths, anterior marginal 0.038, anterior angular about 0.061, mid lateral about 0.046, epimeral about 0.064, posterior marginal 0.077, coxal about 0.043; pterothorax, greatest width 0.355; fore wing, length 0.860, greatest width at base 0.087, least width at middle 0.066; subbasal setae lengths, (a) 0.066, (b) 0.069, (c) 0.077; abdomen, greatest width 0.370; tube, length 0.150, greatest width at base 0.078, least width at apex 0.038; longest seta on segment IX, length 0.117; longest terminal seta, length 0.135.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	43	13	61	72	59	54	46	33
Width in microns	11	36	42	11	33	28	26	13

Total length of antenna . . . 0.111 mm.

Male.

(Macropterous).

Length 1.94 mm. — Very similar to the female in colour, perhaps a shade darker, with the fore tibiae paler, i.e. yellow slightly tinged with pale brown. In structure the two sexes are also similar, the male differing in the following: slightly smaller size, with abdomen broadest across segment II; prothorax longer, 0.61—0.71 times the length of the head, and 2.13—2.37 times as wide across the coxae as its median dorsal length; anterior angular setae longer, longer than the posterior marginals; third subbasal seta always pointed; tube more abruptly narrowed near the base; the fore femora armed with one tooth near the apex (or sometimes with two), and the fore tibiae armed on the inside with a small tooth at about the basal third.

Measurements of male (allotype) in mm. — Length 1.94; head, length 0.215, width across eyes 0.165, greatest width across cheeks 0.183, least width at base 0.160; eye, length 0.069, width 0.051, interval 0.064; post-ocular setae, length 0.066, distance apart 0.133;

longest cheek spine, length 0.015—0.020; prothorax, median dorsal length 0.135, width (including the coxae) 0.320; prothoracic setae lengths, anterior marginal 0.020, anterior angular 0.082, mid-lateral 0.051, epimeral 0.059, posterior marginal 0.079, coxal 0.051; pterothorax, greatest width 0.335; fore wing, length 0.720; subbasal setae lengths, (a) 0.054, (b) 0.061, (c) 0.046; abdomen, greatest width 0.310; tube, length 0.135, greatest width at base 0.077, least width at apex 0.036; abdominal segment IX, length 0.087; spine on IX, length 0.038; longest seta on IX, length 0.107; longest terminal seta, length 0.123.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	36	43	59	64	56	51	43	36
Width in microns	41	31	39	37	29	24	23	13

Total length of antenna 0.388 mm.

Described from 43 females and 7 males, all macropterous, collected on 9.1.1938 by J. H. Joubert, in curled leaves of *Landolphia capensis* Oliv. at Donkerhoek (about 18 miles east of Pretoria), Pretoria, Transvaal.

In contrast to the downward-curling of the margins of *Ficus* leaves, caused by *Gynaikothrips hirsutus* (Karny), the present species lives on the upper surface and causes the leaf edges to curl upwards.

This new species seems to be most closely related to *schoutedeni* Priesner from the Belgian Congo and to *ugandensis* Priesner from Uganda; from the former it may be separated by (1) the pores between the microsetae on abdominal tergum III when both present being nearer together, 20—23 microns compared with 38—48 microns, (2) the relatively longer tube, 0.64—0.67 times the length of the head, and 1.90—1.96 times as long as the greatest basal width compared with 0.61 and 1.79 respectively, (3) the narrower antennal segment IV in the female, 1.7—1.8 times as long as wide compared with 1.35, and the shorter segment V in the male, less than twice as long as wide compared with more than twice as long as wide and longer than III in *schoutedeni*, (4) the presence of a dark longitudinal line on hind wing, and (5) antennal segments V and VI produced ventrally at the apex. From *ugandensis* the present species may be separated by: (1) antennal segments V and VI produced ventrally at apex, (2) relatively narrower antennal segments III—V in the male, 1.42—1.56, 1.61—1.77, and 1.86—1.93 times as long as wide respectively compared with 1.07, 1.36 and 1.44, (3) one pore on tergum III usually absent but when both present then closer to one another, never more than 23 microns apart compared with up to 28 microns, (4) shorter prothoracic and post ocular setae, (5) presence of a dark longitudinal line on the hind wing. Another species with

which it may be compared is *coffear* Bagnall from Tanganyika Territory; it differs from this species in: (1) the shorter spines on abdominal segment IX in the male, (2) antennal segments V and VI produced ventrally at apex, (3) the smaller eyes, 0.33—0.38, compared with 0.45 times the length of the head, (4) the shorter tube, 0.61 — 0.67 compared with 0.75. Another closely allied species is *edentatus* sp. n. from which it may be separated by the characters given in the key.

***Elaphrothrips faurei* sp. n. (Pl. III, Fig. 9, 11).**

Male.

(Brachypterous).

Length about 3.4 mm. General colour dark brown. Head brown, considerably darker between the eyes, including the process in front of the eyes. Antennal segments I and II same colour as basal portion of head, II becoming yellowish towards the apex; III yellow, with extreme apex slightly shaded with brown; IV yellow, with narrowed portion of apex and extreme base shaded with brown; V yellowish brown for about the apical and basal thirds, the remaining third yellow, darker than either III or IV; VI, VII, and VIII dark brown, VI slightly paler on basal half. Prothorax and pterothorax brown. Abdomen brown to dark brown, gradually becoming darker towards apex. All coxae brown. Trochanters yellow. Femora yellowish brown, the yellowing becoming more pronounced at each end. All tibiae and tarsi yellow. All setae clear or slightly tinged with yellow except the terminal setae of the tube, which are shaded with brown at the base.

Head almost exactly three times as long as greatest width, which is near the base, and 3.2 times the width across the eyes; distinctly produced beyond the eyes, the process about 1.3 times as wide at base as median length, 0.41 as long as greatest width of head near base, and nearly as broad at base as at origin of antennae. Small tempora present behind eyes from which the cheeks evenly constrict for a short distance and then widen again until near the base of the head where they abruptly converge to form a slight collar. The length of the cheeks about 2.41 times the least width of the head which is shortly behind the eyes. Vertex of head not overhanging. Ante-ocular setae at least 70 microns in length and about 66 microns apart, more or less pointed; arising about 26 microns from the anterior margin of the eyes. Post-ocular setae about 20 microns long. Post-oculars at least 125 long, 88 microns apart, and 75 microns from the posterior margin of the eyes. Dorsoccephalic setae about 35 microns long, 11 microns apart, and arising about 230 and 205 microns from the posterior margin of the eyes. Cheeks with about four pairs of irregularly placed, strong, knobbed spines, the one immediately behind the

eyes being the longest (about 35 microns); with minor setae interspersed between the major pairs. Eyes, prominent but not distinctly protruding; their length slightly more than 0.21 times that of the head; the measurements in the holotype in microns being:

Dorsal: length 140, width 70, interval 65;

Ventral: length 130, width 72, interval 60.

Interval between posterior ocelli about 60 microns, and their distance from median ocellus about 80 microns; they are situated to the inner margin of eyes within about their apical third. Antennae slender, about 1.38 times as long as the head; segment III about 5.9 times as long as its own width and 1.24 the length of IV; IV about 4 times as long as wide and 1.1 the length of V. Sense cones slender, short (outer one on III about 43 microns) distributed as follows: III 1 (1), IV 1 (2) plus 1 ventrally, V 1 (1+2), VI 1 (1), VII 1 on dorsum; the outer sense cone on VI is much shorter than the inner. Mouth cone short, broadly rounded, almost attaining middle of prosternum.

Prothorax along median line about 0.33 times as long as head and (including the coxae) about 2.2 times as wide as long; surface smooth; epimeron not fused with pronotum; seta lengths in the holotype in microns: — antero-marginals 38, antero-angulars about 55, mid-laterals about 70, epimerals about 90, postero-marginals about 100, coxals 60. Fore legs enlarged but not extremely so, with three stout spines about 46 microns in length, at basal angle in addition to the usual spines; „sickle shaped” spine present, straight or slightly curved, comparatively weak; foretibiae normal but setae at subbasal angle shorter than width of tibiae; one seta within the apical sixth of tibia longer than width of tibia; setae at apex longer than the rest of the foretibial setae; fore-tarsus with a moderately strong tooth, about equal to width of tarsus in length, and with a slight backward curve. Middle and hind legs normal; the femora possessing knobbed setae, the longest placed about midway between base and apex; the lengths of these mid- and hind-femoral setae 50 and 75 microns respectively; hind-tibiae with a strong apical, dorsal seta (about 50 microns long), in addition to the usual setae. Wings rudimentary, padlike, with two subbasal setae on fore wing rudiment, their respective lengths in the holotype in microns being 50 and 75.

Abdomen long and slender at base, slightly wider than the pterothorax. Pores on segment II, 65 microns apart. Lengths of segments VI—IX in microns: 215, 235, 230, 165, respectively; lateral setae on VI 140 microns long and on VIII 105 microns; setae on IX long (440 microns), longer than tube. Tube about 0.6 times the length of the head, and 3 times as long as its greatest basal width, which is about 2.2 times as wide as the least apical width. Terminal setae about 320 microns in length.

Measurements of male (holotype) in mm. — Length about 3.37; head, median dorsal length 0.650, width across eyes 0.205, least width behind eyes 0.180, greatest width across cheeks near base 0.220, least width near base 0.205, width across basal collar 0.210; length of head process in front of eyes 0.090, width at base 0.120, width at base of antennae 0.125; prothorax, median length of pronotum 0.215, width (including coxae) 0.480; pterothorax, greatest width 0.420; abdomen greatest width (II segment) 0.460; tube, length 0.370, greatest basal width 0.120, least apical width 0.055.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	65	68	205	165	150	95	70	80
Width in microns	60 ¹⁾	40	35	40	35	28	25	15

Total length of antenna . . . 0.898 mm.

Female.

(Brachypterous)

Length 3.6 mm. Body stouter than that of male, but otherwise very similar, departing from the above description only as follows: — head 2.9 times as long as width across eyes and 2.72 times the greatest width near base; head process in front of eyes about 1.4 times as wide at base as its own median length, and 0.38 as long as greatest sub-basal width of head. Cheeks about 2.21 times as long as least width of head just behind eyes, anterior pair of genal spines 20 microns long; the post-ocular in the allotype about 90 microns long, 95 microns apart, and 70 microns from the posterior margin of eye; anteoculars about 75 microns long, 71 microns apart, and 26 microns from the anterior margin of eye. Eyes nearly 0.22 the length of the head, their measurements in the allotype in microns being:

Dorsal: length 140, width 70, interval 75;

Ventral: Length 140, width 77, interval 65.

The posterior pair of ocelli are 70 microns apart, and 30 microns from the median ocellus. Antennae about 1.44 times the length of the head; segment III 1.2 times the length of IV and 6 times as long as wide; IV 1.17 times the length of V and 5 times as long as wide. Median pronotal length about 0.34 that of head; pronotal setae measurements in the allotype: antero-marginals 38, antero-angulars 40, mid-laterals 83, epimerals 105, postero-marginals 115, coxals 40. Abdomen stouter than in male but tapering rather than rounding to the tube. Pores on segment II 90 microns apart. Segments VI 215, VII 195, VIII 160, IX 165 microns in length; setae on IX 510 microns long; lateral pairs on VI and VIII 195, 145 microns respectively. Tube about 0.72 the length of the head. Terminal setae about 360 microns in length.

¹⁾ Basal width.

Measurements of female (allotype) in mm. —

Length about 3.6; head, median dorsal length 0.640, width across eyes 0.220, least width behind eyes 0.195, greatest width near base 0.235, least width near base 0.220, width at basal collar 0.225; head process in front of eyes, length 0.090, with at base 0.124, width at base of antennae 0.125; prothorax, median length of pronotum 0.215, width (including coxae) 0.485; pterothorax, greatest width 0.460; abdomen, greatest width (segment II) 0.640; tube, length 0.460, greatest basal width 0.145, least apical width 0.060.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	50	70	210	175	150	110	73	85
Width in microns	60	40	35	35	35	28	23	15

Total length of antenna 0.923 mm.

Described from 4 males and 1 female, all brachypterous, collected by Professor J. C. Faure „among fallen leaves”, July, 1936, at Lourenço Marques, Portuguese East Africa. Found together with specimens of *Elaphrothrips orangiae* Jacot-Guillarmod.

I take pleasure in naming this new form for Professor J. C. Faure of the University of Pretoria, who has done much to advance our knowledge of the Thysanoptera of South Africa.

The yellow tibiae and tarsi and the distinctive colour of antennal segment V are outstanding characters. With other African species it can hardly be confused except perhaps with *E. orangiae* Jacot-Guillarmod also from South Africa, which also has yellow middle and hind tibiae and tarsi; from this species it may, however, easily be separated by the colour of the fifth antennal segment, the much shorter dorsocephalic bristles, and the relatively longer head. From the American species *flavipes* (Hood) which also has yellow mid- and hind-tibiae the new species may be separated as follows: — the relatively longer head, the distinct cone overhanging the base of the antennae absent, and the relatively shorter tube. The presence of a „sickle-shaped” spine on the fore-femora of the male of *faurei* also separates it from both the above species.

Kleothrips (Akleothrips) zuluensis sp. n. (Pl. III, Fig. 10, 12.)

Male.

(Macropterous).

Length about 5.0 mm. Colour brown to dark brown except for the following: antennal segment II tinged with yellow at the apex; III yellow, slightly shaded with brown at extreme apex; IV yellowish brown at apex; V ochreous yellow on basal half, apical half brown; VI to VIII brown. All trochanters ochreous yellow; fore-tarsus yellowish brown, the tooth being ochreous yellow. All bristles hyaline.

Wings colourless. Abdomen pale at base, gradually becoming darker towards apex. Tube brown, paler at apex.

Head 3.3—3.4 times as long as width across eyes, and 3.1—3.3 as long as the greatest width across cheeks, widest at basal collar in the holotype and at about the basal sixth in the paratype; strongly but gradually narrowed behind eyes and slightly so at base; the width behind eyes 0.77—0.78 of the greatest subbasal width. Produced portion of head 1.9 times as long as its own width at base and 1.5 times its width at base of antennae; 1.28 times as wide at insertion of antennae as at base; 0.90—0.96 as long as the width of the across the eyes; steeply narrowing to near middle and then slightly broadening to base; lateral margins of basal half rather irregular. Cheek 2.4 times as long as the least width of head behind eyes. Lateral and dorsal surface of head transversely striate. About 3 pairs of prominent cheek spines plus about 5 pairs of lesser ones present, the 1st situated immediately behind the eyes is the longest, each measuring about 66—77 microns. Ante-ocular setae slightly more than half the dorsal length of the eye, their measurements in the holotype in microns: length 77, distance apart 79, distance from anterior margin of eye 59. Post-oculars about equal in length to the post-oculars whose measurements in the holotype in microns are: length about 25, distance apart 132, distance from posterior margin of eye 87. Dorsocephalic setae about twice as long as the post-oculars, the measurements in the holotype in microns being: length 51, distance apart 105, distance from posterior margin of eye 235. Eyes prominent, bulging, about 0.18 times the length of the head, the measurements in the holotype in microns:

Dorsal: length 145, width 70, interval 100;

Ventral: length 105, width 80, interval 80.

Ocelli of posterior pair situated slightly in front of middle of eye; anterior ocellus much smaller than posterior; measurements in holotype in microns; diameter of posterior ocellus 20, of anterior ocellus 8; interval between posterior ocelli 75; distance from anterior ocellus to posterior ocellus 95. Antennae about 1.5 times as long as head, slender; segment III, 6.96—7.07 times as long as wide and 1.39—1.42 times as long as IV; IV, 4.96—5.1 times as long as wide and 1.46—1.47 times as long as V; segments V and VI produced ventrally at apex, the produced part more distinct in VI. Sense cones well developed, pointed, the outer cone on III about 33 microns in length; the respective sense cones distributed as follows: III 1 (1), IV 1 (2) plus 1 ventrally, V 1 (1 + 1), VI 1 (0 + 1), VII 1 on dorsum. Mouth cone rounded, reaching about middle of prosternum.

Prothorax 1.7 times as wide (including coxae) as long and about 0.4 times as long as head; surface smooth; median thickening present; all usual setae present, pointed excepting those on the

epimera which are slightly expanded at the tip. The epimeral setae at least twice as long as any of the other setae; the anterior angulars, arising from a slight prominence, rather weak, equal to the mid-laterals but shorter than the postero-marginals. Measurements of the prothoracic setae of the holotype in microns: anterior-marginals 30, anterior-angulars 35, mid-laterals 35, epimerals 110—115, posterior-marginals 65, coxals 75. Wings of equal width throughout, with a slight forward curve; about 36 duplicated cilia present on the posterior margin of the fore wing; all subbasal setae of fore-wing pointed, (a) and (b) subequal to one another and to the posterior-marginals of the prothorax; (c) about 1.7 times as long as (a) or (b), shorter than the prothoracic epimerals; their measurements in holotype in microns: (a) 55, (b) 55, (c) 80. Fore femora enlarged, provided with a tooth on the inner side near the apex and in addition a forwardly-curved process on the inner side at about the middle. (In the paratype in addition to the forward curve the process has a slight backward curve at the tip). Fore tibia on the inner side at the apex with a bristle-bearing tooth; subbasal tooth absent. Fore tarsus with a long, straight acute tooth, arising at right angles to tarsus and about 1.25 times as long as the width of the tarsus. Middle and hind legs normal for the genus. Pterothorax wider than prothorax (including coxae), finely reticulate along the sides.

Abdomen long and slender, probably broadest at segment II from which it gradually narrows to tube. Segment VIII about 1.46 times as long as IX. Tube about 0.76 as long as head, and 1.57—2.0 times as wide at base as at apex. Length of longest seta on IX about 300 microns in holotype and longest terminal seta on tube about 330 microns.

Measurements of male (holotype) in mm. — Length about 5.0; head, median dorsal length 0.790, width across eyes 0.240, least width behind eyes 0.200, greatest width across cheeks 0.255, width at basal collar 0.260; head process, length 0.215, width across base 0.113, least width 0.100, width at base of antennae 0.145; prothorax, median length of pronotum 0.290 width (including coxae and coxal tubercles) 0.560; fore-femur, length about 0.600, greatest width 0.250, median tooth, length about 0.130, apical tooth length about 0.040; fore tibia, length about 0.460; tarsal tooth, length 0.100, width at base 0.020; pterothorax, greatest width 0.620; fore-wing, length 1.860, width at middle 0.145; abdominal segment VIII, length about 0.350, width about 0.270; segment IX, length about 0.240, width about 0.190; tube, length about 0.600, greatest basal width 0.105 least apical width 0.067.

Antennal segments	1	2	3	4	5	6	7	8
Length in microns	75	84	325	233	160	113	70	70
Width in microns	69	51	46	47	43	38	31	20

Total length of antenna . . . 1.13 mm.

Holotype, male: Hluhluwe, Zululand, 24-1-1937, „found on car after having driven through long grass” (C. Jacot-Guillarmod).

Paratype, 1 male: White Umfolosi, Zululand, 1922 (R. H. Harris)

The paratype is generally larger (head length 0.860 mm.); it differs from the holotype in the distances of the ante- and post-ocular setae from the eye compared with the distance from each other, and in the larger, slightly differently shaped projection on the fore femora; otherwise it agrees very closely with the holotype.

This species has been placed in the subgenus *Akleothrips* Priesner on account of the large projection on the middle of the inner margin of the fore-femora in addition to the apical tooth; it may, however, easily be separated from *karimnensis* Priesner from Java, the subgenotype by the following points: the colourless wings and the smaller number of duplicated cilia on the fore-wing (35—37 compared with 48—52); additional projection on forefemora situated in the middle instead of the basal third, larger and differently shaped; antennal segments relatively broader; antero-angular and mid-lateral setae on prothorax very weakly developed. The new species comes, however, closest to *separatus* Hood from East Africa which, although the male is not yet known, should probably also be included in the subgenus *Akleothrips*. The South African species differs from the East African form in the narrower head. (3.10—3.25 times as greatest width across cheeks compared with 2.76); the longer head process (1.90—1.92 times as long as width at base, compared with 1.63); antennal segments VII and VIII of the same length, whereas VII is slightly longer than VIII in *separatus*; abdominal segment VIII about 1.5 times as long as IX compared with 1.1.

PL. I.

- Fig. 1. *Hoplandrothrips arrhenus* sp. n. right antenna of female paratype.
Fig. 2. *Hoplandrothrips arrhenus* sp. n. head, prothorax, and fore legs of female paratype (all setae on legs omitted).
Fig. 3. *Hoplandrothrips vansonii* sp. n. head, prothorax, and fore legs of female paratype (all setae on legs omitted).
Fig. 4. *Hoplandrothrips vansonii* sp. n. right antenna of female paratype.

PL. II.

- Fig. 5. *Hoplandrothrips landolphiae* sp. n. right antenna of male allotype.
Fig. 6. *Hoplandrothrips landolphiae* sp. n. head, prothorax, and fore legs of male allotype (all setae on legs omitted).
Fig. 7. *Hoplandrothrips edentatus* sp. n. head, prothorax and fore legs of male holotype (all setae on legs omitted).
Fig. 8. *Hoplandrothrips edentatus* sp. n. right antenna of male holotype.

PL. III.

- Fig. 9. *Elaphrothrips faurei* sp. n. left antenna of male holotype.
Fig. 10. *Kleothrips* (*Akleothrips*) *zuluensis* sp. n. head, prothorax and fore legs of male holotype.
Fig. 11. *Elaphrothrips faurei* sp. n. head, prothorax and fore legs of male holotype.
Fig. 12. *Kleothrips* (*Akleothrips*) *zuluensis* sp. n. left antenna of male holotype.

Plate I.

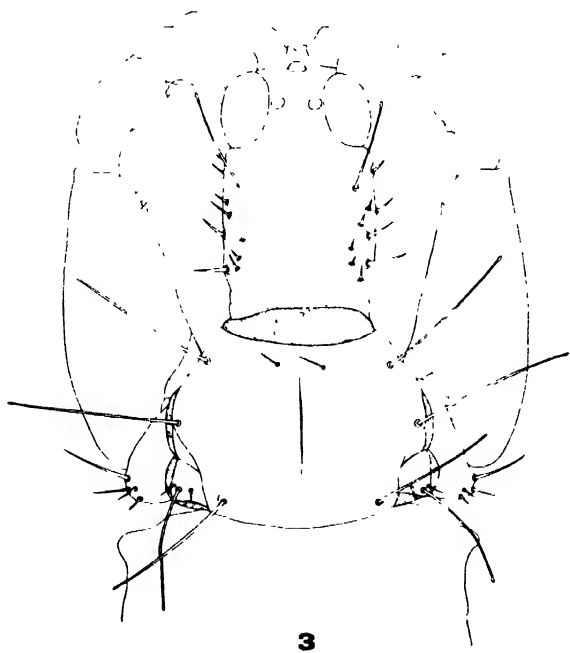
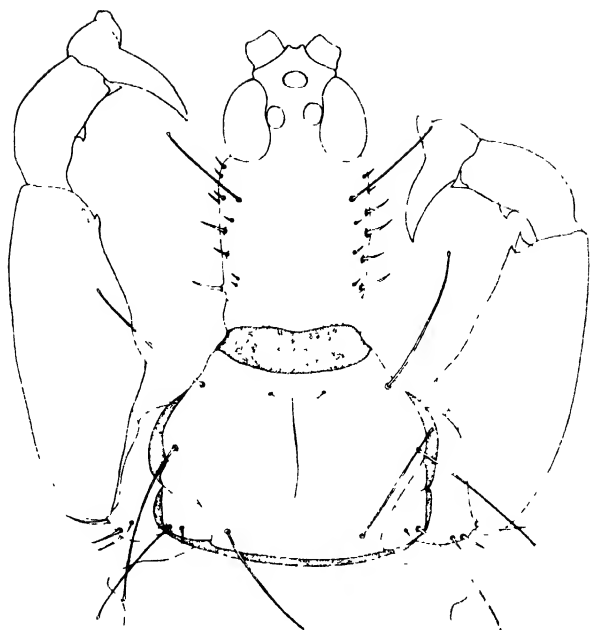
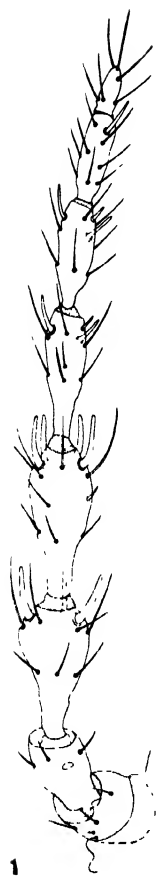
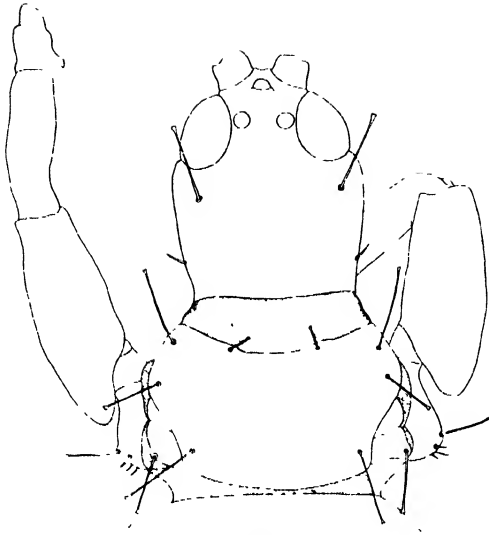


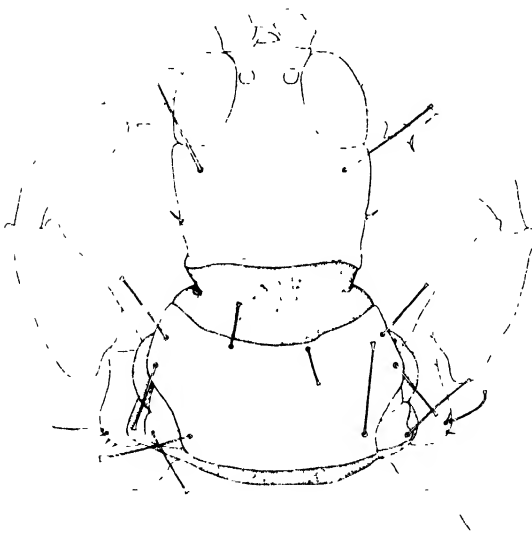
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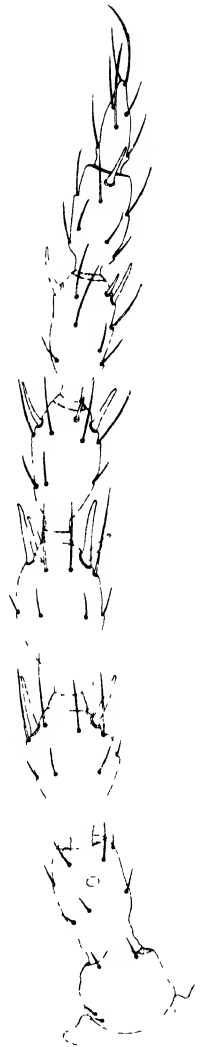
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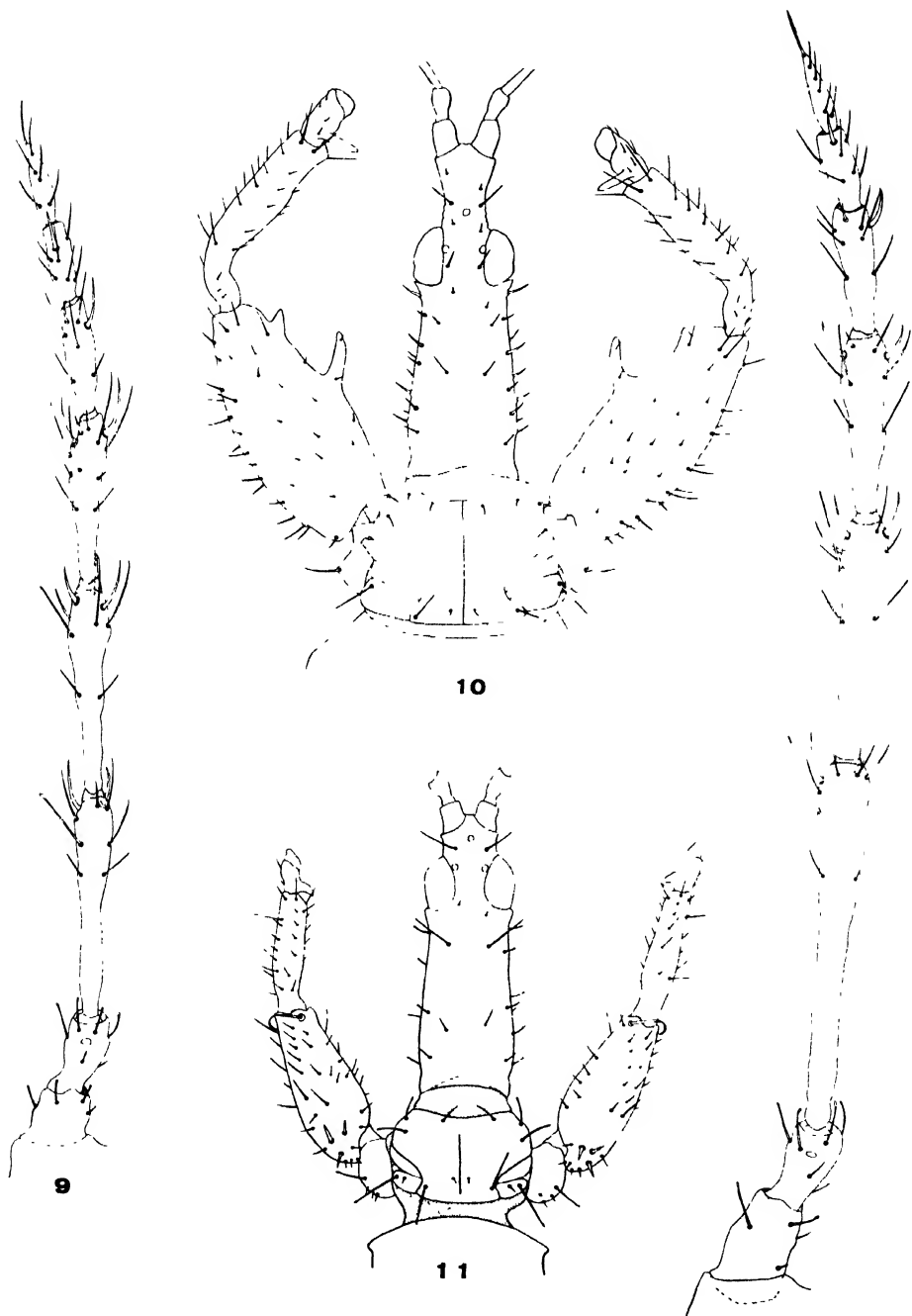


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8

Plate III.



On the South African Cuculliaë (Noctuidæ)

by

A. J. T. JANSE.

This group of *Noctuids* belongs to the tribe *Trifini*, which has M2 of the hindwing more or less obsolescent and from middle of DC or from just below middle. The *Cucullia* are distinguished from allied sub-tribes by having smooth eyes (hairy in the *Hadenæ*), mid- and hindtibiæ without spines (with spines, or at least with the hindtibiæ so, in the *Agrotides*), and the eyes with overhanging eyelashes (not present in the *Acronictæ*).

This last character is somewhat difficult to observe, as the hairs are sometimes rather short or somewhat hidden by the frontal hairs or scales and mistakes have been made in cases where other characters were neglected. One case in point may be mentioned here, namely *Ectocheila nigrilineata*, which I now find to be a typical *Centrarthra* in every respect, especially according to the male genitalia, and even in respect of the tuft which overhangs the eye.

As the name indicates, the typical genera such as *Cucullia* and the genera close to it, have the tegulæ produced, thus forming a more or less distinct hood; however, many genera placed here do not even show a distinct ridge or crest on the prothorax.

In two genera the foretibiæ have a terminal claw, which may be somewhat hidden in the hairs; a minute drop of benzine or toluol placed on the spot renders it quite distinct (when present) as a brownish, pointed, curved process. The proximal joints of the foretarsi sometimes have a series of short, curved, clawlike spines which must not be confused with the tibial claw.

Members of this group are found all over the world, but are comparatively lightly represented in South Africa. Many of the South African species, especially those of *Cucullia*, have very obscure markings which make it easy to confuse them, but a study of the male genitalia makes determination quite certain, even of species hardly separable by wing markings.

KEY TO THE GENERA.

- 1a. Foretibia with a strong, curved claw at extremity 2.
- b. Foretibia without a claw 3.
- 2a. Tegulæ produced, so as to form a hood; cilia, overhanging the eyes, spreading *Copicucullia*, p. 112.

- b. Tegulæ not produced; overhanging cilia form a distinct tuft, not spreading *Ectocheila*, p. 121.
- 3a. Frons with a corneus, truncate prominence, partly hidden in the scales *Grammoscelis*, p. 130.
- b. Frons smooth, rounded 4.
- 4a. Tegulæ produced to form a more or less distinct hood 5.
- b. Tegulæ not produced 7.
- 5a. Abdomen with at least one dorsal crest 6.
- b. Abdomen without any crests *Empusada*, p. 101.
- 6a. Forewing with termen rather oblique, apex somewhat produced; R3 anastomosing with terminal half of stalk R4, R5; M1 from areole; hindwing with M3 and C1 from a point; C2 obsolescent; hood pronounced *Cucullia*, p. 82.
- b. Forewing with termen less oblique and apex not produced; R3 only anastomosing with free part of R4; M1 remote from areole; hindwing with M3 and C1 remote; C2 very weak but present; hood rather small *Neocucullia*, p. 108.
- 7a. Proboscis well developed 11.
- b. Proboscis rudimentary 8.
- 8a. Antennæ of male bipectinate; forewing rather broad at termen, costa straight or arched 9.
- b. Antennæ of male biserrate; forewing with costa somewhat concave; tornus well rounded into termen and inner margin, making the wing rather narrow *Ulochlaena*, p. 116.
- 9a. Thorax clothed hair only and without crests *Dasypolia*, p. 130.
- b. Thorax clothed with hair and with scales or hair-like scales mixed, also with spreading crests 10.
- 10a. Thorax with rough hair and scales mixed; termen of forewing crenulate; hindwing with RS and M1 very shortly stalked *Rhodochlæna*, p. 113.
- b. Thorax with hair and hair-like scales mixed; termen of forewing almost even; hindwing with RS and M1 well separated *Leucochlæna*, p. 115.
- 11a. Abdomen without any dorsal crests *Cattistis*, p. 121.
- b. Abdomen with at least one dorsal crest 12.
- 12a. Abdomen with a dorsal crest at base only 13.
- b. Abdomen with more than one dorsal crest 14.
- 13a. Prothorax with divided crests; frons with a transverse ridge of scales *Charidea*, p. 119.
- b. Pro- and meta thorax without crests; frons roughly scaled, but without transverse ridge *Hypotype*, p. 127.
- 14a. Thorax clothed with hairs and scales mixed *Eumichtis*, p. 126.

- b. Thorax clothed with hairs and hair-like scales mixed
 *Rhizotype*, p. 130.

**KEY TO THE SPECIES, of which the males have been studied,
 according to their genitalia.**

- 1a. Uncus with a hooked lobe on upper side
 *Neocucullia albisignata*, p. 111.
 b. Uncus without a hooked lobe on upper side 2.
 2a. Uncus with two lateral at apical half
 *Hypotype scotomista*, p. 129.
 b. Uncus without any lobes 3.
 3a. Base of abdomen with two lateral coremata, covered with long
 hairs hidden in pockets 4.
 b. Base of abdomen without lateral coremata 10.
 4a. Vesica with two cornuti 7.
 b. Vesica with more than two cornuti 5.
 5a. Vesica with four cornuti *Cucullia nigrilinea*, p. 88.
 b. Vesica with three cornuti 6.
 6a. Harpes of both valves of even length *Cucullia minuta*, p. 87.
 b. Harpe of right valve very long and curved, of left valve practi-
 cally absent *Cucullia inaequalis*, p. 82.
 7a. Harpe narrow, long and straight 8.
 b. Harpe curved towards tip or rather broad 9.
 8a. Valve at tip about twice as broad as at middle, produced and
 pointed at tip; clavus rather short and broad
 *Cucullia dardalis*, p. 91.
 b. Valve only a little broader at tip, apex slightly produced and
 roundly pointed; clavus rather long and narrow
 *Cucullia terreusis*, p. 87.
 9a. Uncus straight at middle; harpe broad, just reaching beyond
 costa; valve narrow, sharply produced at tip (genotype from
 Europe) *Cucullia artemista*, p. 82.
 b. Uncus well arched at middle; harpe narrow, reaching beyond
 costa for half its length; valve rather broad, more roundly
 produced at apex *Copicullia rupifascia*, p. 113.
 10a. Sacculus without a distinct clavus 11.
 b. Sacculus with a distinct clavus 17.
 11a. Vesica without stout cornuti but it may be more or less covered
 with minute teeth 12.
 b. Vesica with distinct cornuti 13.
 12a. Valve very much contracted beyond middle; harpe very long;
 vesica with large patches densely covered with minute teeth
 *Charidea elegantissima*, p. 121.
 b. Valve gradually tapering towards tip, sole-shaped; harpe rather

- short; vesica with very few minute teeth
 *Rhodochlæna botonga*, p. 114.
- 13a. Vesica with two cornuti 14.
 b. Vesica with more than two cornuti 15.
- 14a. Uncus very broad at middle; cornuti minute
 *Leucochlæna leucogonia*, p. 116.
 b. Uncus narrow at middle; cornuti stout and long
 *Ulochlæna fumea*, p. 118.
- 15a. Vesica without a patch densely covered with numerous short
 spine-like cornuti but with five stout cornuti, of which three are
 large; terminal lobe of ædæagus with saw-like teeth
 *Ectocheila nigrilineata*, p. 123.
 b. Vesica with a terminal patch densely covered with numerous
 short spinelike cornuti; terminal portion of ædæagus without
 saw-like teeth; cornuti numerous or, if five in number, one is
 very large, the other four very small 16.
- 16a. Valve very much contracted before middle; vesica with about
 60 small irregularly shaped cornuti
 *Caffristis terrognisca*, p. 126.
 b. Valve tapering towards rounded tip, vesica with one very stout,
 broadly based cornutus and four very small cornuti
 *Eumichtis rubrimixta*, p. 127.
- 17a. Vesica with two pointed cornuti 22.
 b. Vesica with more than two pointed cornuti 18.
- 18a. Vesica with four pointed cornuti, of which one is rather small
 *Empusada argenticitta*, p. 105.
 b. Vesica with three pointed cornuti 19.
- 19a. One of the three cornuti bulbous at base, the others somewhat
 broadly based *Cucullia brunnea*, p. 93.
 b. None of the three cornuti bulbous at base 20.
- 20a. Uncus undulating towards tip, valve obliquely rounded at tip but
 without a corona of inwardly directed bristles
 *Empusada hutchinsoni*, p. 101.
 b. Uncus downcurved at tip; valve with tip oblique and with a
 corona of inwardly directed bristles 21.
- 21a. Vesica with a chitinous, suboval patch densely covered with
 teeth, in addition to the cornuti; valve with a narrow lobe from
 below costa projecting well beyond inner margin
 *Empusada chrysota*, p. 106.
 b. Vesica without such a chitinous patch; valve with a broad lobe
 originating from inner margin
 *Cucullia pallidicolor*, p. 98.
- 22a. One or more cornuti bulbous at base 23.
 b. None of the cornuti bulbous at base 21.
- 23a. Both cornuti bulbous at base, one of the cornuti about one-third

- the size of the other; in addition a broad chitinated patch covered with theeth *Empusada pallidistria*, p. 107.
- b. Only one cornutus bulbous at base, the other much smaller, one only broadly based; vesica without a chitinated patch *Cucullia consimilis*, p. 94.
- 24a. Vesica with a chitinated patch or with a long lobe from ædæagus covered or edged with teeth 25.
- b. Vesica without such a chitinated patch or lobe 26.
- 25a. Valve obliquely arched at tip; harpe from well before middle of valve; one cornutus about twice as long as the other, the longest broadly based *Cucullia platti*, p. 93.
- b. Valve evenly rounded at tip; harpe from middle of valve; both cornuti of even length, one a little stouter than the other, both narrowly based *Cucullia extricata*, p. 95.
- 26a. Valve narrowest at middle; harpe projecting a little beyond costa, somewhat curved towards base; clavus rather narrow; vesica with a suboval chitinated patch with teeth along the whole edge except at the narrow base; in addition the ædæagus has a long lobe edged on one side with teeth; cornuti long and moderately thick *Cucullia albifusca*, p. 99.
- b. Valve gradually tapering somewhat towards obliquely rounded apex; harpe not projecting beyond costa, straight and oblique; clavus broad and rounded; vesica without a suboval chitinated patch but with a lobe from ædæagus edged with teeth; cornuti rather short and thick at base 27.
- 27a. Harpe rather narrow and somewhat long, just reaching the costa; largest cornutus almost straight and with two ridges well below it on the lobe of the vesica, these ridges are beset with very fine spines *Cucullia atrimacula*, p. 96.
- b. Harpe rather broad and short, not reaching the costa; largest cornutus somewhat curved like a claw and with one chitinated ridge at base of its lobe which is beset with very fine teeth *Cucullia persciata*, p. 96.

Genus **CUCULLIA** Schrank (Figs. 1—4; pl. IV.—VI.)

Cucullia Schrank, Fauna Boica, II. (2), p. 157 (1802); Hmps., Cat. Lep. Phal. VI. p. 14 (1906); Gaede, Seitz Gross-Schmett. XV. p. 55 (1934) ¹⁾.

Type: *artemisiæ* Hufn. from Europe. (Plate VI. 2).

Proboscis well developed; palpi obliquely upturned, reaching a little beyond frons, second and first joint of almost even length,

¹⁾ For synonymy of all genera and species in this paper see Hampson's Catalogue Lepidoptera Phalaenæ vol. VI.

densely covered with scales, fringed with hair-like scales below on first joint, tufted with scales in front on second joint, third joint about one-third of second joint, covered with short appressed scales; eyes large, suboval; frons with a slightly rounded prominence and a small ridge above proboscis, densely and loosely covered with scales; antennæ simple, first joint with a tuft of scales; vertex loosely covered with scales; tegulæ covered with scales, tipped with long hair-like scales and upturned above the scales of the thorax, so as to form a hood with a ridge in the middle; thorax above densely covered with hair-like scales, below mixed with hairs; foretibia and tarsi without a claw; femora and tibiæ of all legs loosely covered with hair-like scales, fringed with very long hair-like scales posteriorly; hindtibia with four spurs covered with appressed scales, outer spurs nearly half of inner spurs; tarsi with three rows of spines on inner side over the whole length; abdomen with dorsal crests on the first three segments, first crest very long, third crest composed of loosely fitting hair-like scales (in some species absent), middle crest of rather short densely fitting moderate scales (in some species obsolescent); two lateral coremata on second sternite, hidden in a pouch and covered with very long spreading hairs; the anal tuft of long hair is somewhat bifid. *Forewing*: rather elongate, costa well arched towards apex, termen oblique, slightly crenulate, inner margin almost straight, slightly bulging at basal half; cell a little over half of wing; R1 from before two-thirds of upper median; R2 and R3 on a stalk of nearly one-third of R2 and from middle of origin of R1 and upper angle; R4 and R5 on a stalk of one-third of R5; R3 anastomosing with half of stalk of R4-R5 and with one-third of free part of R4, thus forming a large elongate areole (in most S. African species the stalk of R4 and R5 only goes as far as the areole); M1 from areole; M2 from three-fourths of DC; upper DC very weak, strongly incurved; C1 a little further from M3 than M2 is; C2 from three-fourths lower median; A2 simple at base, somewhat undulating; on underside a dense tuft of long hair from uppermedian over the whole length, overhanging the cell, and a similar but smaller tuft from middle of cell. *Hindwing*: triangular, with costa well curved before apex, termen arched, slightly crenulated, tornus rounded, inner margin well arched; cell a little over half of wing; Sc anastomosing with the upper median well beyond base for a short distance, thus forming an elongate, narrow, subbasal cell, the upper median being there very weak; RS and M1 from upper angle, M2 obsolescent (almost leaving no trace except near termen; M3 and C1 from lower angle; C2 from about two-thirds lower median; DC rather weak, incurved; A2 and A3 straight.

Male genitalia: uncus stout, strongly curved near base, then straight, narrowing before apex where there is a slight bulge

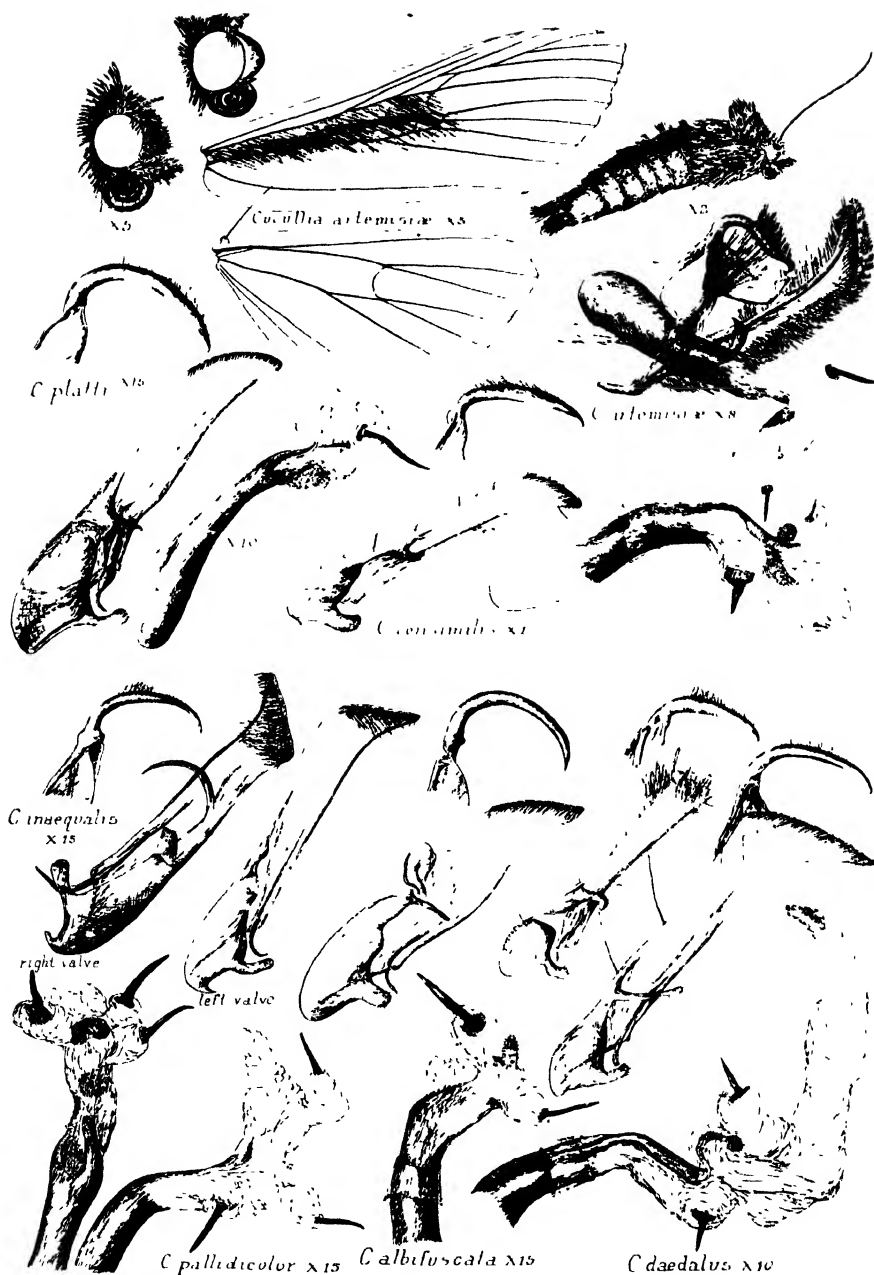


Fig. 1. Heads, (one with frons denuded), wing venation and ♂ genitalia of *Cucullia artemisiæ* (genotype, from Europa); uncus, left valve and penis of *C. platti*, *C. consimilis*, *C. inaequalis* (also with right valve), *C. pallidicolor*; *C. albifusca* and *C. daedalus*.

on upper side, then suddenly contracted to a fine curved point, on upper side densely covered with hair forming a triangular tuft; tergite rather broad, well chitinised and with a fringe of long hair posteriorly; sternite narrow, forming a short saccus at base and well chitinised; anus narrowly chitinised basally; valve narrow, of almost even width, costa upturned at terminal half, termen very oblique and short, provided with a corona of densely situated marginal spines; costa broadly chitinised, remainder of valve less so, except the sacculus from the base of which originates a broad, short, pointed harpe; outer side of valve densely covered with scale-like hairs on inner margin, which are short near termen, with long hairs at costa for terminal half; sacculus with a very short rounded clavus; ædæagus stout, thickest at base, moderately chitinised; vesica with two stout cornuti, each at the end of a lobe, one cornutus being stouter and somewhat curved; two other lobes without cornuti; near base of vesica a somewhat chitinised patch partly covered with minute granules.

This genus has many Palæarctic representatives, very few from India, a small number from North America, a few reaching as far as Mexico, a small number from the Ethiopian region (mostly from South Africa) and none from the Indo-Australian and South American regions. About 100 species have been described.

The South African species may be distinguished as follows:

- 1a. Forewing with orbicular and reniform quite distinct 2.
- b. Forewing with orbicular and reniform indistinct, at most represented by a few black points 8.
- 2a. Forewing with the area between antemedial and postmedial lines darker than before antemedial and beyond postmedial lines 3.
- b. Forewing with the whole area of even colour, except sometimes at costa 5.
- 3a. Ground-colour of forewing avellaneous; vertex, tips of tegulæ and the thorax as dark as the middle area of the forewing (clove brown) *platti*, p. 93.
- b. Ground-colour of forewing pale mouse grey or even paler; vertex, tegulæ and thorax of the same ground-colour as the forewing 4.
- 4a. Forewing with the antemedial line very distinct and well defined from costa to lower median; reniform evenly rounded on inner side; an oblique black fascia from beyond the postmedial to termen between inner marginal fold and M3; terminal black marks linear, narrow, broad and confluent between C1 and A2 *nigrilinea*, p. 88.
- b. Forewing with the antemedial line obsolescent between costa and lower median; reniform inwardly produced on lower median; no oblique black fascia between M3 and inner marginal fold;

- terminal black marks lunular, nowhere confluent
 *terrensis*, p. 87.
- 5a. Forewing with a black narrow fascia at inner margin from beyond base to postmedial line or beyond 6.
- b. Forewing without a black fascia at inner margin 7.
- 6a. Ground-colour of thorax and forewing pallid mouse grey; of hindwing pale pinkish buff, translucent *consimilis*, p. 94.
- b. Ground-colour of forewing vinaceous-buff; of hindwing pinkish buff, not translucent *brunnea*, p. 93.
- 7a. Ground-colour of thorax and forewing pale vinaceous-fawn, partly tinged with smoke grey, orbicular and reniform inconspicuous, slightly defined by a narrow dark line *dædalis*, p. 91.
- b. Ground-colour of thorax and forewing hair brown, tinged and irrorated with fuscous; orbicular and reniform conspicuous, paler than ground-colour and well defined by a narrow black ring *inæqualis*, p. 89.
- 8a. Forewing with a narrow black fascia in cell from base, extended between M2 and M3 as far as where the subterminal line should be *perstriata*, p. 96.
- b. Forewing without a black fascia in cell 9.
- 9a. Forewing with a curved fuscous fascia below end of cell, being the remains of the lower edge of the reniform, and continued into the oblique diffused fascia from apex *minuta*, p. 87.
- b. Forewing without such a fascia 10.
- 10a. Forewing with a narrow black line at inner marginal fold from base to antemedial, which is obsolescent, and another black line from there above it till before base of C1; an oblique broad fascia from inner marginal fold well before tornus and reaching the termen *extricata*, p. 95.
- b. Forewing without such black lines and without a black fascia reaching the termen 11.
- 11a. Thorax light buff; ground-colour of forewing warm buff and not irrorated; forewing without well defined transverse lines or fasciæ, only the postmedial is somewhat indicated; hindwing white, translucent, with a slight narrow clouding along termen and a hair brown terminal edging *pallidicolor*, p. 98.
- b. Thorax and forewing light buff but well irrorated and clouded with fuscous, or thorax and forewing light drab irrorated and clouded with fuscous; transverse lines for the greater part distinct; hindwing broadly bordered along termen with hair brown 12.
- 12a. Head, thorax and ground-colour of forewing light buff, irregularly irrorated with fuscous, so as to give the forewing a mottled appearance; expanse 35 mm. *albifuscata*, p. 99.
- b. Head, thorax and ground-colour of forewing light drab, fairly

evenly suffused and irrorated with fuscous; expanse 47 mm.
 *atrimacula*, p. 96.

Cucullia terrens Feld. (Fig. 2; pl. IV. 4.)

Cucullia terrens Feld., Reise Nov. pl. 108, f. 53 (1874); Hmps., Cat. Lep. Phal. VI. p. 46, pl. XCVIII. fig. 21 (1906); Gaede, Seitz Gross-Schmett. XV. 56, pl. 7 (1934).

Male genitalia: two lateral coremata at base of abdomen, hidden in pouches and covered with very long hair; uncus stout, strongly curved at base, then well arched, gradually tapering to a fine curved point, covered with hair on upper side; tergite of almost even width, rather weakly chitinised, except anteriorly, tufted with hair posteriorly; sternite narrow, moderately chitinised, ending in a short curved saccus; anus not chitinised below; valve rather narrow, strongly upcurved terminally at costa, corona well developed, costa narrowly chitinised, remainder of valve weakly so; sacculus rather narrow and with a long clavus, which is slightly contracted at middle and terminally covered with short hair; harpe from one-third of inner margin, moderately chitinised, narrow, roundly pointed, projecting for nearly half its length beyond the costa; ædæagus weakly chitinised, stout; vesica with two short lobes near base, each with a stout broadly-based cornutus one of which is slightly smaller; another lobe near base with a curved, broad, chitinised band, covered with minute teeth; a very long lobe without armature, finely punctulated along terminal fourth.

Exp. 44—48 mm. *Hab.* Type from Damaraland (South West Africa); also recorded from Cape Town and Durban. In my collection from Uitenhage, Ngqeleni (Pondoland), Durban, Rietvlei (Natal), Umvuma; February and November.

Cucullia minuta Möschl. (Fig. 2; pl. IV. 6.)

Cucullia minuta Möschl., Verh. z.—b. Ges. Wien. XXXIII. p. 295; pl. XVI. f. 9 (1883); Hmps., Cat. Lep. Phal. VI. p. 55, pl. XCVII. fig. 15 (1906); Gaede, Seitz Gross-Schmett. XV. p. 57, pl. 7 (1934).

Male genitalia: two lateral coremata at base of abdomen, hidden in pouches and densely covered with long hair; uncus stout, strongly curved at base, well arched beyond, tapering to a fine point, rather sparsely covered on upper side with hair; tergite moderately chitinised, heavily so anteriorly, fringed with long hair posteriorly; sternite narrow, longer than tergite, ending in a short saccus; anus slightly chitinised below; valve as in *artemisæ* but somewhat broader; a well developed corona; three stout bristles at almost even space on inner margin in addition to the fringes of hair on outer side of valve; fringe along costa and outer side of valve longer but more

sparsely distributed, sacculus rather broad and with a moderate clavus which is constricted at middle, rounded at tip and there covered with a few bristles; from just beyond saccus an almost straight harpe, projecting a little beyond costa and ending in a blunt point; ædæagus rather weakly chitinated except the two terminal lobes; vesica with three basal lobes, each covered with a cornutus; middle ones shortest and less stout, the shorter lateral one bulbous at base, the longer lateral one broadly based; between this and the smallest cornutus a chitinated curved band, densely covered with minute teeth; beyond middle cornutus a long tubular lobe, finely punctulated at terminal third.

Exp. 40—43 mm. *Hab.* Type from Grahamstown; also recorded from Annshaw (Cape Colony). In my collection from Bloemfontein, Thaba'nchu, Pretoria; February, April and October.

Cucullia nigrilinea spec. nov. (Fig. 4; pl. V. 6, pl. VI. 9.)

♂. Head, thorax and forewing drab grey; abdomen and hindwing light buff; palpi irrorated with black, densely so on third joint, which is rather long; first and second joint fringed in front with light buff scales and hair-like scales; frons and vertex roughly scaled with light buff, drab grey and black scales mixed; cilia over the eyes black, tipped with whitish; tegulæ with a black fascia along posterior edge; patagia with some blackish scales on posterior edge; metathorax with a spreading crest of black scales. *Forewing*: basal half of wing, especially along medial portion, and area along costa before apex well irrorated with fuscous; nearly all the veins narrowly edged with black and a narrow black line on inner marginal fold; a small black macula at costa and one below lower median, indicating the subbasal line; antemedial black, broad but diffused, from costa to inner margin, angled outwardly in cell, below inner marginal fold and below A2, angled inwardly on lower median and A2; two inwardly oblique broad black maculæ above and below inner marginal fold before antemedial and indications of a similar macula at costa; orbicular large, rounded, narrowly edged with black and broadly centred with fuscous, touching the antemedial; reniform sub-oval, large, obliterated on outer side, accentuated on inner side by a black edging, touching a small diffused black macula at costa; postmedial obsolescent, from costa to C2, then narrow, black, angled inwardly at inner marginal fold, outwardly on A2, inwardly oblique to inner margin; two narrow black fasciæ above and below inner marginal fold from antemedial to postmedial, converging towards postmedial and meeting there; three small light buff points at costa well before apex and a similar macula near apex; subterminal line absent but a black elongated suffusion below R5, before where the subterminal line would have been and a similar suffusion beyond it between veins M2 and C2 and above and below inner marginal fold;

a series of black terminal lunules between the veins, which become confluent and broader between C1 and A2; cilia irrorated with hair brown, the basal half narrowly chequered with whitish opposite the veins. *Hindwing*: veins densely irrorated with fuscous; a broad terminal border lightly irrorated with fuscous and diffused on inner side; cilia of ground-colour.

Male genitalia: abdomen with lateral coremata each covered with a hair-pencil fitting into a pocket; uncus stout, strongly curved at basal half, then almost straight and tapering to a fine point, covered on upper side with moderate hairs; tergite broad, well chitinised, especially along the anterior edge; sternite narrow, well chitinised, terminating in a short saccus; anus without chitinisation; valve of almost even width, except at middle where it is contracted owing to the incurved inner margin; apex slightly produced; termen very oblique, almost straight and with a corona consisting of rather long bristles; apical area densely tufted with long hairs; some long hairs along the margins; inner side sparsely covered with short hairs; sacculus rather short and provided with a broad rounded clavus; costal area of valve well chitinised, remainder weakly so; harpe from before middle of valve, in right valve projecting a little beyond costa, broad and terminally with some short hairs, in left valve only half that size; ædæagus well chitinised, of almost even width, somewhat curved; vesica with three stout moderately based cornuti of which two are almost of even length, the third about two-thirds of the longest; a broad chitinised curved band with very few short teeth; basal portion of vesica finely punctulated.

Exp. 38 mm. *Hab.* Bloemfontein (Irving) 20 September 1924.

This species closely resembles *consimilis* in general colouration, while the hindwings are more like those of *brunnea*, but the pronounced black lines on the veins readily differentiate it from the former and the postmedial marking between C2 and A2 distinguish it from the latter; moreover, in *consimilis* the cornuti are much smaller and none of them have the basal bulb of the one cornutus of *brunnea*; unfortunately only one specimen has come to my notice.

***Cucullia inaequalis* spec. nov.** (Fig. 1; pl. V. 10; pl. VI. 8.)

♂, ♀. Head, thorax and forewing light mouse grey, heavily irrorated with fuscous; palpi with the scales fuscous, tipped with whitish, first and second joint fringed with pinkish buff hair; scales on frons with a transverse fuscous fascia across middle, which is incurved in the centre and outwardly oblique at the ends which are directed towards base of antennæ; vertex tufted with fuscous scales between base of antennæ; basal joint of antenna tufted with hair-like spreading scales tipped with white, partly fuscous, partly sayal brown; tegulæ with a black fascia across base and another fascia of

sayal brown before posterior edge and a terminal edging of sayal brown; patagia sprinkled with sayal brown; abdomen white at base then pinkish buff, first three segments with small black crests; metathorax with a crest of ground-colour mixed with black; hindwing pale pinkish-buff, almost white at base and translucent. *Forewing*: subbasal indicated by two oblique black maculae at costa with a ground-colour in between and another black macula below lower median; antemedial double, black, diffused and broad between costa and inner marginal fold, then narrow and strongly inwardly oblique to A2, then interrupted and continued below A2 but parallel to the portion between inner marginal fold and A2; all veins narrowly edged with black; orbicular large, rounded, edged with black and filled in with a ground-colour irroration; medial line indicated by a broad, oblique, diffused, black macula from costa to reniform; reniform large, oval, somewhat constricted at middle, edged with black, filled in with ground-colour and some pinkish buff scales; postmedial very faint between costa and C2, excurved and slightly angled inwardly between the veins, below C2 distinct as a black triangular mark on inner marginal fold and with some pale scaling before and beyond it, then continued across A2 to inner margin as a narrow ill-defined black macula; three small whitish points at costa beyond postmedial; subterminal indicated by some ill-defined small black maculae between the veins; a terminal series of black lunules between the veins, which are confluent above and below C2; cilia of ground-colour, with basal half somewhat darker and sprinkled with whitish scales. *Hindwing*: veins densely irrorated with fuscous, terminal border broad, pale fuscous, diffused on innerside; cilia whitish, of ground-colour at base and with some pale fuscous scales at basal half from apex to C2. In the specimens from the Transvaal, especially the females, the general colour of head, thorax and forewing is somewhat tinged with olive-brown and the markings on the forewing tend to become obliterated; another specimen from Bloemfontein has the ground-colour of the forewing pale grey and the irroration is more patchy, giving it a somewhat mottled appearance, but the genitalia of both these forms are identical; some specimens show a very narrow black line between lower median and inner marginal fold, joining the postmedial.

Male genitalia: abdomen with lateral coremata covered with long hair, hidden in pouches; uncus moderately stout, tapering to a fine point, strongly curved at basal third, remainder well arched, upper side with moderate hairs; tergite rather broad, narrow at basal half, well chitinised, especially along anterior edge, fringed with long hair-like scales posteriorly; sternite rather short, narrow, tapering to a short saccus; anus slightly chitinised below; valve of almost even width with costa and inner margin somewhat undulating, apex slightly produced, termen oblique, straight or slightly arched and

with a coronna consisting of rather long bristles; inner side of terminal half of valve sparsely covered with hair, terminal area well tufted, outer side covered with long hair-like scales, becoming short and curved along termen and terminal area of innermargin; sacculus rather narrow and with a broad moderately long clavus, which is terminally rounded and constricted basally; harpe of right valve very long, from middle of valve near inner margin, tapering to a fine point and well curved (the harpe of this species is longer and more chitinated than any of the other species known to me though the length varies a little and so does the curving); left valve without a harpe, but at its place a minute bulge a little above inner margin (this is the only species in South Africa known to me which has the harpe of the left valve so much reduced but several specimens have been examined for this character and they were found to be constant); aedeagus well chitinated, broadest at base, terminating in a punctulated process, which gradually merges into the vesica; vesica three lobed, each lobe with a cornutus; all cornuti stout and broadly based, but of different length, the shortest with a small basal bulb; between the three cornuti a broad chitinated patch, which is somewhat curled up but evidently without teeth.

This species may easily be confused with *brunnea* which, however, has the outer half of the reniform obsolescent, the lines are more diffused and the postmedial mark between C2 and A2 has in that species a transverse dark line across the pale scaling before the triangular black macula; the hindwing is darker basally; the genitalia are totally different as regards shape of uncus, shape of harpe and the cornuti.

Exp. 34—45 mm. *Hab.* Male type, Bloemfontein (Irving), 2. III. 21; female type, Bloemfontein (Irving) 9. XII. 22. Five male cotypes, three from Bloemfontein (Irving) IX., X., XII.; five female cotypes from Bloemfontein (Irving), in III., IX., XI., and one from Thaba'nchu (Edelsten), October 1924. Of the specimens in which the forewing is tinged with olive-brown two male cotypes are from Pretoria (Janse), in II. and X., three female cotypes from Pretoria (Janse), I., Johannesburg (Cooke), III., and Johannesburg (Linford), I.

Cucullia dædalis spec. nov. (Fig. 1; pl. V. 11; pl. VI. 10.)

Head, thorax and forewing pale smoke grey, more or less irrorated with fuscous-black; palpi of the same colour, without any transverse lines; some faint hair brown transverse lines across the tegulae and a fuscous-black transverse line near base; patagia without any lines; first basal abdominal crest large, black, second one small of groundcolour, tipped with fuscous; abdomen and hindwing tiller buff, the former somewhat irrorated with drab-grey. *Forewing:*

a narrow black line from base to antemedial on inner marginal fold; subbasal indistinct, fuscous; antemedial fuscous, indistinct from costa to base of C2 and with another hair brown line parallel to it and well beyond it, then from base of C2 broader and more distinct, inwardly oblique to A2, then outwardly dentate below A2, then to one-third of inner margin; orbicular indistinct, pale, rounded and narrowly edged with black in type; reniform pale in type, narrowly edged by black, extended from R1 to well below lower angle, lower half broadest, basal half of C2 more or less edged with black; terminal third of A2 and some of the other veins edged with black but less so in ♀ type; postmedial indistinct in type, in cotype broad but diffused, hair brown, excurved beyond cell, somewhat angled inwardly on inner marginal fold, outwardly on A2; subterminal indicated by irregular blotches of ground-colour without any irroration; a terminal series of narrow black lunules between the veins; cilia hair brown, basal half somewhat darker and chequered with ground-colour of wing opposite the veins. *Hindwing*: veins somewhat streaked with hair brown; a broad hair brown terminal border, somewhat darker along termen; cilia tilleul buff, sprinkled with hair brown along base.

The male type is in a somewhat discoloured condition owing to a previous slight attack of mould; the female type is more clearly marked and has a fresher appearance and though smaller is no doubt conspecific to the male.

Male genitalia: base of abdomen with lateral hair pencils, hidden in pockets; uncus stout, curved at base, then almost straight and tapering to a curved point, well tufted with hair on upper side; tergite moderately broad, well chitinised anteriorly, tufted with long hair posteriorly; sternite narrow, well chitinised, ending in a short rounded saccus; anus slightly chitinised below; valve long, rather narrow, of almost even width, strongly produced at apex, where the otherwise straight costa is strongly curved; termen oblique, almost straight and with a corona of closely fitting bristles; costal area well chitinised; remainder of valve, except basal third, weakly chitinised; inner side of valve covered with hairs, outer side with hair-like scales along inner margin, along costa for terminal half with long bifid scales; saccus rather narrow and provided with an elongated clavus, covered on inner side with short bristles; harpe from about one-fourth of valve, a little above inner margin, long and projecting well beyond costa, parallel, slightly curved towards tip, which is rounded and covered with some short bristles; in addition to the scale-like hairs along inner margin there are two long bristles, one from beyond harpe and one from middle of inner margin; aedeagus stout, strongly curved at middle, well chitinised and terminating in two narrow lobes which are densely granulated and gradually merge

into vesica; manica finely granulated above; vesica with two short basal lobes, each provided with a moderate, stout, broadly based cornutus; between the lobes a narrow, curved, well chitinated band, covered with minute teeth; beyond this a long tubular lobe, diminishing in width towards tip and there finely granulated.

This species comes closest to *terrensis*, but that species has a more clearly marked forewing and the apex of the valve is far less produced.

Exp. Male type 48 mm.; female type 39 mm. *Hab.* male type Enquabeni (Natal), December 1909; female type Krantzklouf 23rd. March 1917 (L. Hargreaves).

***Cucullia brunnea* Hmps. (Fig. 2; pl. IV. 1.)**

Cucullia brunnea Hmps., Ann. S. A. Mus. II. p. 277 (1902); Cat Lep. Phal. VI. p. 30, pl. XCVI. fig. 27 (1906); Gaede, Seitz Gross-Schmett. XV. p. 35, pl. 7 (1934).

Male genitalia: abdomen without coremata at base; uncus stout, curved at base, then almost straight, tapering to a slightly curved point, a tuft of hair on upper side beyond base; tergite rather broad, moderately chitinated, except the anterior ridge, fringed with moderate hair posteriorly; sternite very narrow, about as long as tergite, ending in a pointed saccus placed at right angle; anus slightly chitinated below; valve of almost even width, slightly contracted towards middle, broadening towards apex which is obliquely rounded and provided with a well developed corona; outer side and edges of valve covered and fringed with hair, mixed with short scales towards apex; costa broadly chitinated, remainder less so; sacculus rather short and with a long, broadly rounded clavus, covered with very short hair; harpe very short, hardly reaching beyond costa, weakly chitinated; aedæagus stout, weakly chitinated; vesica with three lobes near base, each terminating in a cornutus; cornuti of almost even length but one bulbous at base and somewhat curved, the others broadly based and straighter; at conjunction of lobes a rather wavy chitinous band, densely covered with minute spines, beyond this a long tubular lobe finely punctulated at tip.

Exp. 33—35 mm. *Hab.* Type from Buntingville (Cape Colony); also recorded from Transkei and Uganda; in my collection from Stellenbosch, Bloemfontein, Rosmead, Thaba'nchu. March, May, September, October and November.

***Cucullia platti* Prout. (Fig. 1; pl. V. 7; pl. VI. 4.)**

Cucullia platti Prout, The Entomologist, LVIII. p. 213 (1925); Gaede, Seitz Gross Schmett. XV. p. 57 (1934).

Male genitalia: abdomen without lateral coremata at base; uncus stout, evenly curved, strongly so at base, tapering to a fine

point, sparsely covered on upper side with moderate hairs; tergite rather short, moderately chitinised, fringed with hair-like scales posteriorly; sternite rather narrow, almost twice length of tergite, gradually tapering to a short saccus; anus slightly chitinised below; valve of almost even width, obliquely rounded at tip; corona consisting of very short bristles, almost hidden in rather dense covering of hair on inner side of valve; outer side of valve covered with hairs and hair-like scales; sacculus rather broad and provided with a curved, broadly rounded clavus, terminally provided with some short bristly hairs; beyond sacculus from middle of valve a well chitinised harpe, hardly reaching beyond costa, broad at base, suddenly contracting beyond middle; ædæagus well chitinised, rather slender, terminating in two long lobes that are finely granulated; vesica with two cornuti but without a chitinised band; one cornutus almost twice as long as the other, stouter and somewhat undulating, both broadly based and tapering to a point.

Exp. 39—41 mm. *Hab.* Type from Durban. In my collection from Durban, Kranskloof, Estcourt and Salisbury X—XII; bred by E. E. Platt from larvæ feeding on *Colendula*.

***Cucullia consimilis* Feld. (Fig. 1; pl. V. 9.)**

Cucullia consimilis Feld., Reise Nov. pl. 108, f. 52 (1874); Hmps., Cat. Lep. Phal. VI. p. 30 (1906); Gaede Seitz Gross-Schmett. XV, pl. 55, pl. 7 (1934).

Cucullia pusilla Möschl., Verh. Z.-b. Ges. Wien, XXXIII. p. 296, pl. XVI. f. 10 (1883).

Male genitalia: Base of abdomen without lateral coremata; uncus stout, slightly thicker before middle, then tapering to a fine curved point, basal fourth strongly curved, then straight; tergite rather broad, well chitinised, tufted with long hair posteriorly; sternite rather narrow, well chitinised, terminating in a pointed saccus, set almost at right angles; valve of almost even width, narrow, slightly wider at base, upcurved towards apex, termen very oblique, slightly arched and with a corona of moderate bristles, basal half and a ridge along costa moderately chitinised, remainder less so: sacculus with a rather long, broad, rounded clavus, provided with a few short bristles terminally; terminal portion of sacculus near costa very heavily chitinised, so as to form a triangular patch which takes no stain; a moderately chitinised ridge along inner margin till beyond middle, from which originates a short, roundly pointed harpe; inner side of valve sparsely covered with long hair, outer side with very long hair, mixed with bristles along the inner marginal edge, outer side of termen with curled hairs mixed with scales; ædæagus rather stout, thickest at base, well chitinised and terminating in a rather long narrow process, which gradually merges into the vesica and is

densely covered with minute teeth, terminally it merges into a large chitinised patch on the vesica, also covered with minute teeth; vesica with four lobes; each of the three basal lobes terminates in a cornutus; longest cornutus with a chitinised bulb at base; medium sized cornutus much shorter and with a somewhat broad base; third cornutus minute, stout.

Gaede remarks (l.c.) "that he figures *pusilla* Möschl. and that Felder's figure of *consimilis* looks quite different"; this is quite true and though Gaede's figure is somewhat different from the one given by Möschler yet they resemble what I have as *consimilis* more than Felder's figure does, except for the more pronounced terminal border of the hindwing, which is vague and ill-defined in Möschler's and Gaede's figures. Felder's figure looks very much like *extricata* and it is quite well possible, that what I give as *consimilis* should be named *pusilla* and that Felder's *consimilis* must be looked upon as a synonym of *extricata* Walker. However, these hand-painted figures cannot be trusted, especially in this group where the species closely resemble each other in markings. Only a thorough study of the genitalia of the types can settle this problem. As Hampson had probably seen Walker's and Felder's types I provisionally follow his nomenclature.

Exp. 30—35 mm. *Hab.* Type from Knysna; also recorded from Bloemfontein; Annshaw (Cape Colony), Grahamstown, Rosmead, Concordia. In my collection from Bloemfontein and Thaba'nchu; III., IX.—XI.

Cucullia extricata Wlk. (Fig. 2: pl. IV. 3.)

Cucullia extricata Wlk., Cat. XI. p. 630 (1857); Hmps., Cat. Lep. Phal. VI. p. 46, pl. XCVII. fig. 6 (1906); Gaede, Seitz Gross-Schmett. XV. p. 56, pl. 7 (1934).

Male genitalia: abdomen without basal coremata; uncus stout, slightly wider at middle, tapering to a point, well arched, strongly so at basal half, some hairs on upper side; tergite rather broad, moderately chitinised, fringed with hair posteriorly; sternite rather narrow, moderately chitinised, ending in a rounded saccus; valve of almost even width, slightly wider at base, almost straight, terminally rounded, rather weakly chitinised, a little stronger so along basal third and along costa; sacculus with a rather long clavus, which is terminally rounded and covered with some short hairs; corona along rounded termen with the bristles curved and directed inwardly, so as to be difficult of observation; inside of valve moderately covered with long hair, outside densely so, mixed at terminal area with curved hair-like scales; harpe stout at base, contracted beyond middle, projecting well beyond costa, terminal half forming three

ridges; ædœagus rather weakly chitinised terminally, upper side densely beset with minute teeth; vesica tubular, with two lobes near base, each lobe provided with stout, broadly based, curved cornuti; the one nearest the base being thinnest.

Exp. 43—48 mm. *Hab.* Caffraria (Cape Colony); also recorded from Knysna, Annshaw, Transkei and Natal. In my collection from Pondoland and Durban; I.

***Cucullia perstriata* Hmps. (Fig. 2; pl. IV. 2.)**

Cucullia perstriata Hmps., Cat. Lep. Phal. VI., p. 43; pl. XCVII. fig. 5 (1906); Gaede, Seitz-Gross-Schmett. XV. p. 56, pl. 7 (1934).

Male genitalia: abdomen without basal coremata; uncus stout, curved at base, then straight, tapering to a curved point, covered with hair on upper side; tergite rather narrow, weakly chitinised, except along anterior edge; sternite narrow, more chitinised, ending in a rounded upturned saccus; valve narrow, of almost even width at basal half, then gradually tapering, costa slightly upcurved, termen obliquely rounded and with a corema consisting of rather long bristles; a number of bristly hairs at intervals along lower terminal edge; basal half of valve and along costa moderately chitinised, remainder less so; sacculus rather narrow and provided with a short rounded clavus; harpe rather broad, straight, almost reaching costa, terminally rounded and with a series of short hairs along posterior edge; terminal third of valve covered with long hair on inner side, whole of outer side covered with long hair mixed with scales and hair-like scales; ædœagus short and stout, weakly chitinised, gradually merging into the vesica, which has two short basal lobes, each with a cornutus; a longer central lobe without cornutus, but for the greater part finely punctulated; at base of vesica a chitinised ridge provided with triangular teeth, probably a continuation of the ædœagus; the one small lobe with a curved chitinous patch at base, densely covered with minute teeth, (the cornutus of this lobe has a broader base, is stouter and somewhat more curved than the other cornutus).

Exp. 42 mm. *Hab.* Type from Buntingville (Cape Colony); also recorded from Transkei and Uganda. In my collection from Estcourt (Natal).

***Cucullia atrimacula* Hmps. (Fig. 2; pl. IV. 5.)**

Cucullia atrimacula Hmps., A.M.N.H. 8, IV. p. 385 (1909); Gaede, Seitz. Gross-Schmett. XV. p. 57, (1934).

Male genitalia: very similar to those of *perstriata* but the valve is a little shorter and more oblique terminally; the harpe is a little longer and narrower; the clavus is more constricted at base;

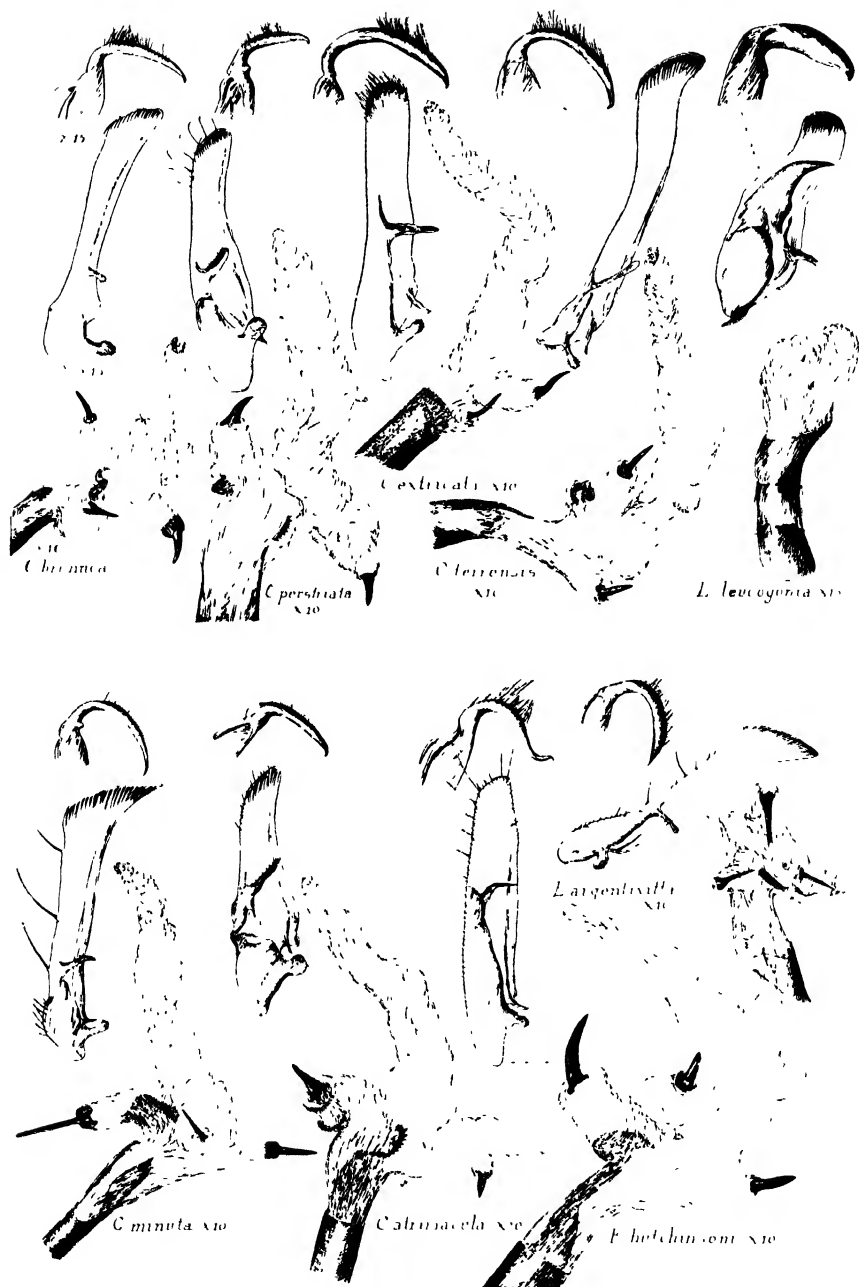


Fig. 2. Uncus, left valve and penis of *Cucullia brunnea*, *C. perstriata*, *C. extricata*, *C. terrensis*, *Leucochlæna leucogonia*, *Cucullia minuta*, *C. atrinacula*, *Empusada hutchinsoni* and *E. argentivitta*.

the uncus is the same, except for the base being a little broader; ædœagus stout, rather short and weakly chitinised, gradually merging into the vesica, which is granulated on upper side at base; vesica as in *perstriata*, but apparently with an additional lobe; the two cornuti as in *perstriata* but stouter at base and not curved; the toothed ridge as in *perstriata* and more clearly connected with ædœagus; chitinous patch at base of the one lobe narrower, but more heavily chitinised and also covered with very fine teeth; terminal half of long lobe densely covered with slightly chitinised minute teeth.

Exp. 44—46 mm. *Hab.* Type from the Transvaal. In my collection from Durban and White River; II.

Cucullia pallidicolor spec. nov. (Fig. 1; pl. V. 8; pl. VI. 6.)

Head, thorax, abdomen and ground-colour of forewing pinkish buff; hindwing pure white, translucent; palpi and frons irrorated with fuscous; underside pale pinkish buff. *Forewing*: subbasal only represented by a few fuscous scales; lower median and base of C1 and C2 streaked with fuscous-brown; antemedial consisting of two fuscous-brown lines, parallel to each other, beginning from lower median, strongly zigzagged outwardly on submedian fold, inwardly on A2, outwardly below A2, but not reaching as far as above A2; a few fuscous scales below costa, representing the antemedial above upper median; orbicular represented by two small fuscous spots below upper median and a few fuscous scales above lower median, space between these spots somewhat paler than ground-colour; reniform represented by two small fuscous spots above and below upper median and a few black scales between the base of veins R5 to C1; above this a series of small fuscous maculæ oblique from costa to one-fourth of R5, representing the origin of the postmedial, then obliterated till below C2, then continued as two narrow double fuscous fasciæ, angled inwardly at submedian fold, outwardly above A2, then oblique to beyond middle of inner margin; space between those lines and beyond outer line paler than ground-colour; beyond this on innermarginal fold a lunulated fuscous macula; a broad irroration of black scales along a little over terminal half of innermargin; three small white spots beyond postmedial at costa; a series of small terminal black maculæ between the veins, which become lunules below C1; cilia of ground-colour with a somewhat darker base. *Hindwing*: terminal half of veins narrowly irrorated with hair brown and with a slight terminal irroration of hair brown from apex to C2, at tornus ill-defined; rather broad hair brown lunules between the veins; cilia white with a faint hair brown line across before middle; abdominal crests fuscous; abdomen above somewhat irrorated with hair brown.

Male genitalia; base of abdomen without hair pencils; uncus moderately stout, of almost even width, suddenly pointed at tip, strongly curved at base, well curved beyond; tergite rather short, moderately chitinised, stronger so along anterior edge, posterior edge fringed with long hair; sternite rather long, moderately chitinised, terminating in a moderate saccus; anus hardly chitinised below; valve of almost even width, somewhat undulating; termen very oblique, slightly arched and with a corona of closely situated bristles; terminal half of valve weakly chitinised, rather sparsely covered on inner side with moderately long hairs, more densely with longer hairs on outer side; basal half better chitinised, especially the sacculus, which is rather narrow and has a rather broad clavus, which is rough on outer side and covered with a few short hairs; from end of sacculus, just above inner margin, a weakly chitinised, rather narrow harpe, not quite reaching costa; immediately beyond harpe a moderately chitinised broad lobe, projecting well beyond inner margin and covered on outer side with short hair (this lobe I have not found in any other species of this genus, except a possible representative of this in the right valve of *inacqualis*, but situated there before the harpe); ædæagus rather stout, weakly chitinised, terminating in two slightly more chitinised lobes; vesica with four lobes, three of which are each provided with a rather long, stout, narrowly based cornutus.

This species resembles in general colouration and markings *extricata* mostly, but that species has black strigæ below lower median and along inner marginal fold and the dark macula near tornus is continued to termen, also the shape of the valve is quite different and the vesica has there only two cornuti.

Exp. 38—12 mm. Male type from New Hanover (Hardenberg), November 1914; female type from Sarnia (Williamson), February 1912; one male and one female cotype from Durban and Barberton in February and January respectively.

Cucullia albifuscata spec. nov. (Fig. 1; pl. V. 5; pl. VI. 7.)

Head, thorax and forewing tillenul buff; palpi at sides, frons and vertex densely irrorated with fuscous-black; tegulæ with a narrow black line across base, a hair brown fascia across middle and tips fuscous; the tegulæ form a well pronounced hood; patagia on inner side well irrorated and fringed with black; metathorax somewhat tufted with black and whitish scales mixed; hindwing hyaline white. *Forewing*: subbasal indicated by a narrow black line from costa to upper median, angled outwardly at middle and by a small black dash below lower median; inner marginal fold with a narrow black line from beyond base to antemedial; antemedial beginning as an oblique black fascia from costa to upper median, then

interrupted in cell and continued as a pronounced black streak along lower median from base of C2 to about middle of lower median, then a double black outwardly oblique line above upper median, then an inwardly oblique black line to A2, with a broad fuscous fascia before it and parallel to it, then a narrow black line below A2 directed outwardly, then angled inwardly as a broad fascia to inner margin; some whitish scaling before this and some fuscous clouding towards base; orbicular and reniform obliterated; medial line indicated by an oblique black fascia from costa to upper median, then obliterated; a similar fascia, but shorter and followed by some white scales, indicates the postmedial, which is then obliterated except for a black point between R5 and M1 and a black curved striga from M2 to C2, then interrupted, except for some black scaling along the veins and continued as a strongly incurved black fascia between veins C2 and A2, then as a narrow fascia inwardly oblique to inner margin; area before and beyond the postmedial indications blotchily tinted in small area with hair brown; most veins beyond it narrowly streaked with black; costa beyond it broadly edged till before apex with black and with three white points in it; subterminal indicated by some hair brown clouding before and beyond it, and by a diffused triangular black macula on C2; a terminal series of small black maculae, which become almost confluent below C2; diffused white strigæ beyond the postmedial between veins R5 to M2, M3 and C1; a black striga, edged on upper side with white, between M2 and M3 and terminally tipped with white; cilia of ground-colour, irrorated with hair brown, but with basal white V-shaped marks opposite the veins which are continued into the wing between the terminal maculae. *Hind wing*: a moderately broad terminal hair brown border, diffused on inner side; veins partly streaked with hair brown; cilia whitish, with some hair brown scales at base.

Male genitalia: abdomen without basal hair pencils; uncus stout, somewhat curved at base, then almost straight and tapering to a slightly curved point, covered with hair on upper side; tergite moderately broad, almost parallel, moderately chitinised, more strongly so along the edges, posterior edge fringed with long hair-like scales; sternite rather short, narrow, well chitinised, terminating in a rather long roundly pointed saccus, anus slightly chitinised below; valve rather narrow, narrowest just before middle, broadest and best chitinised at basal half, terminal half less chitinised except along costa (unfortunately both valves had the very tips damaged, but at the tornus one of the terminal corona bristles is still preserved, so I suspect the termen to be about as oblique as in *pallidicolor*, but not as broad; this is indicated by the dotted line in the illustration); terminal inner surface densely covered with long hair, remainder more sparsely so, outer surface covered with bifid hair-like

scales; sacculus rather short, terminating in a irregularly shaped well chitinised clavus, which has some short bristles at tip; harpe well chitinised, not firmly connected with end of sacculus, of almost even width, projecting a little beyond costa, incurved, with a broad base and with short hairs on the outer side; ædæagus stout, well chitinised, slightly arched, terminating in a long well chitinised lobe, terminally covered with short teeth, gradually merging into vesica; vesica with two lobes, each terminating in a broadly based cornutus, one cornutus long and very stout, the other half that thickness and somewhat shorter; between them an oval, elongated, heavily chitinised patch (cornutus?), edged for the greater part with strong teeth; vesica partly finely punctulated.

This species resembles in colouration *pallidicolor* somewhat, but the very distinct markings differentiate it, from all the species recorded from South Africa. Moreover, the genitalia differentiate it at once from the other South African Cuculliids by the oval chitinised patch edged with teeth.

Exp. 35 mm. *Hab.* Male type Bloemfontein (Irving), 2-III-'21. Only one specimen is known to me.

Species auctorum.

Cucullia leucopis Hmps., Cat. Lep. Phal. VI., p. 28, pl. XCVI. fig. 26; Gaede, Seitz Gross-Schmett. vol. XV. p. 55, pl. 7 (1934).

I have seen two specimens in the British Museum belonging to this species: the female type from Grahamstown and another specimen from the Transvaal.

Cucullia clausa Wlk., Cat. XI. p. 657 (1857); Hmps., Cat. Lep. Phal. VI. p. 42, pl. XCVII. fig. 3 (1906); Gaede, Seitz Gross-Schmett. XV. p. 56, pl. 7 (1934).

The type of this species is in very bad condition and is from an unknown locality; Hampson gives it as "probably from South Africa", without giving any reason, so it is quite well possible that it is not from South Africa, seeing that it has not been found since.

Genus EMPUSADA Hmps. (Figs. 2, 3, 4.)

Empusada Hmps., Cat. Lep. Phal. VI. p. 85 (1906); Gaede, Seitz Gross-Schmett. XV. p. 57 (1934).

Empusa Hübn., Verz. p. 247 (1827), preocc., Ill. Orth. (1798). Type *lactea* from Europe.

Description from *hutchinsoni*.

Proboscis strongly developed; palpi obliquely upturned, reaching beyond frons, 2nd joint about twice first joint, 3rd joint about half of first joint and smoothly scaled, 1st and 2nd joint evenly fringed in front with long appressed scales and with a few laterally pointed

hairs from 1st and 2nd joint; frons roundly bulging on upper side and with a small ridge above proboscis, covered with loose fitting scales and hairs mixed; scaling of vertex similar; antennae simple, 1st joint without a tuft; eyes large and rounded; fringe consisting of a few over-hanging spreading hairs; tegulae forming a pronounced hood, pointed and somewhat ridged in the middle; thorax and patagia covered with hair-like scales and hairs mixed and without a crest; abdomen without crests, covered with scales, basal two-thirds slightly covered with long hairs, mainly situated on anterior edge of each segment; tibiae and femora covered with scales and hair-like scales mixed and fringed with long hair posteriorly; tarsi with three rows of rather long spines; hindtibia with four spurs; outer spur a little shorter than half of inner; all spurs sharply pointed, tips without scales. *Forewing*: elongate, with costa strongly arched at apical third, termen very oblique and almost straight, innermargin straight; cell a little over half of wing; R1 from well beyond middle of upper median; R2 and R3 on a stalk of a little over one-fourth of R2 and from two-thirds origin of R1 and upper angle; R4 and R5 stalked for one-sixth of R5; R3 anastomosing with R4 from end of stalk R4 and R5 for one-third of free part of R4, thus forming a long narrow areole; M1 from upper angle; upper DC fairly strong, sharply incurved into cell as far as a little beyond origin of R1, thus forming the inner edge of the silvery white fascia of wing; M2 and M3 almost from a point; C1 well remote from lower angle; C2 from about three-fourths of lower median; A2 simple at base, almost straight. *Hindwing*: almost semicircular, apex well rounded, termen a little oblique and somewhat incurved, tornus rounded into inner margin, costa straight; cell much less than half of wing; Sc very shortly anastomosing with upper median at one-third thus forming a narrow basal cell; RS and M1 very shortly stalked; DC very weak, strongly angled into cell as far as origin of C2; M2 obsolescent and from one fourth of DC; M3 and C1 shortly stalked; C2 from two-thirds lower median; A2 and A3 almost straight. Forewing on underside with a dense fringe of long hair overhanging the cell and with a smaller one from middle of cell.

Male genitalia: base of abdomen without lateral coremata; uncus stout, gradually tapering towards tip, strongly curved at basal third, then upcurved beyond middle and ending in a fine down-curved point, upper two-thirds with long hair, longest at middle; tergite moderately broad, of almost even width, rather weakly chitinised, a little stronger along anterior edge; sternite very narrow but more chitinised than tergite, ending in a short roundly pointed saccus; lower part of anus slightly chitinised and finely granulated; valve of almost even width, long and rather narrow, obliquely rounded at termen, without a corona but with some rather

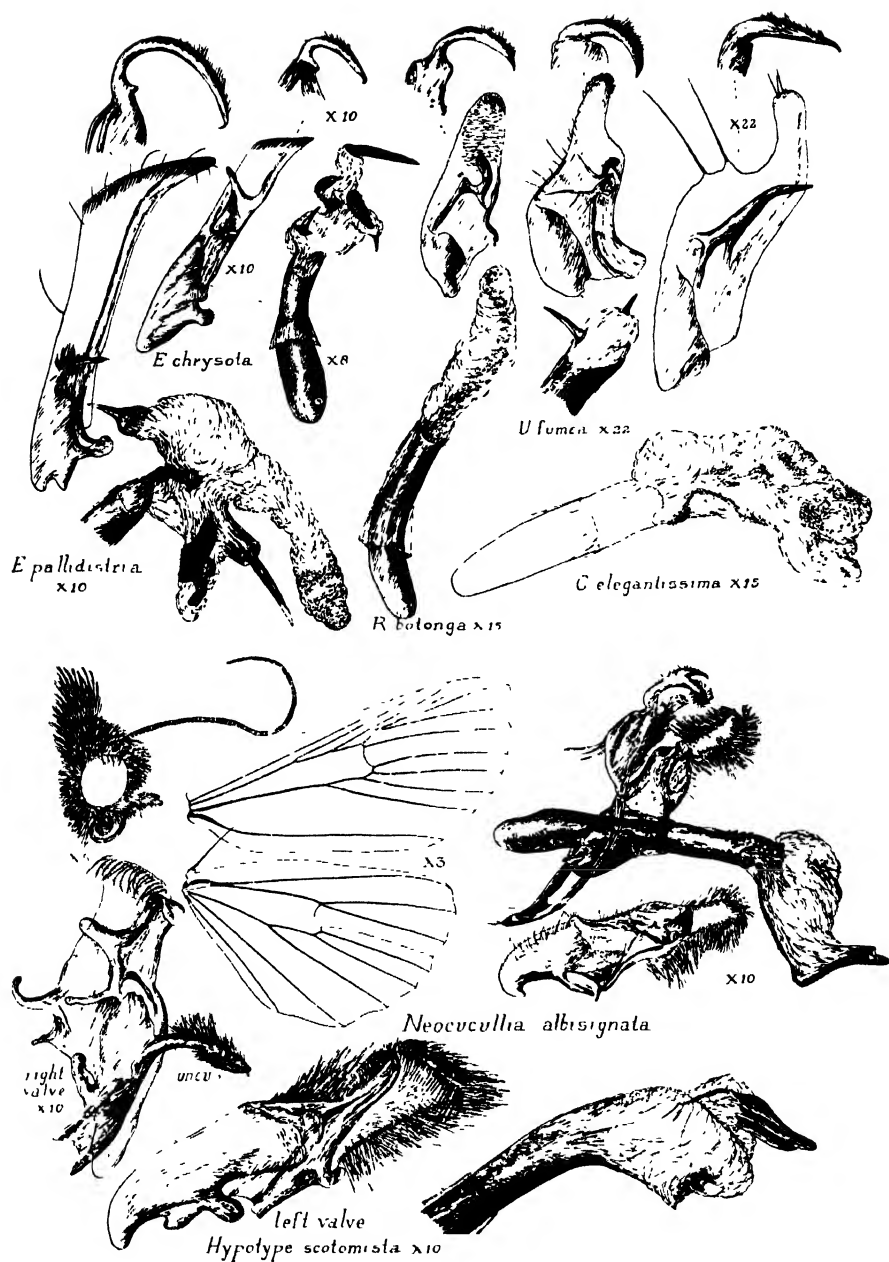


Fig. 3 Uncus, left valve and penis of *Empusada pallidistria*, *E. chrysota*, *Rhodochlæna botonga*, *Ulochlæna fumea*, *Charidea elegantissima*; head, wing venation and ♂ genitalia of *Neocucullia albisignata*; uncus, right- and left valve and terminal portion of penis of *Hypotype scotomista*.

long widely spaced bristles, which are continued along inner margin; basal half of valve rather weakly chitinised, terminal half even less chitinised and sparsely covered on inner side with short papillated hairs; outer side of valve well covered with long hairs and hair-like scales mixed; sacculus rather long and narrow and with a short irregularly shaped clavus, covered on outer side with short hairs; at end of sacculus, above inner margin, a well chitinised harpe, strongly angled at middle, just reaching to costa, basal half rather thick, then tapering to a fine point, outer edge at middle with some short hairs; ædæagus weakly chitinised, of almost even width, rather short, ending in two slightly chitinised lobes, which merge into the vesica and of which the longer one forms a chitinised patch on the vesica; manica finely granulated; vesica with four lobes, of which one is long and terminally granulated; the remaining three lobes are short and each is provided with a stout broadly based cornutus; two cornuti of almost even length, one almost twice that length and somewhat curved.

The male genitalia of this species are hardly typical of the genus, as compared with the other three species which follow: the uncus has a peculiar shape and is evenly curved in the others, where also the valve has a very oblique termen and a distinct corona; the armature of the vesica, however, shows considerable relationship.

Seven species have been placed in this genus which do not occur in South Africa, one from Argentine, five from Europe, one from Madagascar; the five South African species may be distinguished as follows:

- 1a. Forewing with a silvery white fascia in medial fold to termen of wing 2
- b. Forewing without a silvery white fascia 3
- 2a. Silvery white fascia from well before origin of C2 to termen; below it, and extended below lower median till base of wing, a broad rust brown irroration *hutchinsoni*
- b. Silvery white fascia from above origin of C2, no distinct rust brown irroration below it *argentivitta*
- 3a. Forewing with a black streak on lower median and with a grey-white patch below end of cell *pyrostroma*
- b. Forewing without such a black streak and without grey-white patch below end of cell 4
- 4a. Forewing with two or three black points in end of cell ...
..... *chrysota*
- b. Forewing without black in end of cell *pallidistria*

***Empusada hutchinsoni* Hmps. (Figs. 2, 4; pl. IV. 7.)**

Cucullia hutchinsoni Hmps., Ann. S. A. Mus. II. p. 276 (1902).

Empusada hutchinsoni Hmps., Cat. Lep. Phal. VI. p. 87, pl. XCVIII. f. 13 (1906); Gaede, Seitz Gross-Schmett. XV. p. 57, pl. 7 (1934).

Exp. 45—46 mm. *Hab.* Type from Estcourt (Natal), also recorded from Mooi River. In my collection from Durban, Karkloof, Estcourt, Johannesburg and Salisbury; in January, March and December.

***Empusada argentivitta* Hmps. (Fig. 2; pl. IV. 8.)**

Empusada argentivitta, Hmps., Cat. Lep. Phal. VI. p. 87, pl. XCVIII. f. 14 (1906); Gaede, Seitz Gross-Schmett. XV. p. 57 (1934).

Male genitalia: abdomen without basal coremata; uncus very stout, broadest beyond middle, rather suddenly tapering to a slightly curved point, strongly curved beyond base, then almost straight, terminal half with long hairs above; tergite of almost even width, moderately chitinated, a little more so along anterior margin; sternite very narrow, a little more chitinated, ending in a very short saccus; anus slightly granulated below, but hardly chitinated; valve of almost even width, slightly narrower at middle on account of somewhat incurved costa and inner margin, broadening towards apex, termen oblique, slightly arched, and with a corona of closely fitting bristles; most of the valve rather moderately chitinated, covered on inner side with long hair, on outer side with long hairs and scale-like hairs mixed, inner margin with three widely placed bristles; sacculus rather long, narrow and with a subovate clavus with short hairs on outer edge; at end of sacculus from above inner margin an almost straight, narrow, weakly chitinated harpe, projecting beyond costa and somewhat spatulate at tip; aedeagus weakly chitinated, rather stout and with two lobes merging into vesica; vesica with five lobes, four of which have a terminal cornutus, all broadly based, one cornutus about twice as long as the two others and all three very stout; the fourth is much shorter than the two and thinner (in the preparation, and as shown in the illustration, it is seen from the base only); near base of vesica an elongated ribbon-like patch, which is well chitinated and terminates in a rather heavily chitinated, rounded and curved portion, densely beset with short teeth; a long lobe from vesica without cornuti, but terminally finely granulated.

Exp. 36—43 mm. *Hab.* type from Transkei, also recorded from Maseru. In my collection from Bloemfontein, Thabanchu, New Hanover, Pretoria and Matlala (Zoutpansberg District); II., IX.—XI.

Empusada chrysota Hmps. (Fig. 3; pl. IV. 9.)

Empusada chrysota Hmps., Ann. S. A. Mus. II. p. 277 (1920); Hmps., Cat. Lep. Phal. VI. p. 88, pl. XCVIII. f. 17 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58, pl. 7 (1934).

In this species the DC of the forewing is somewhat incurved and obsolescent, in the hindwing the DC is also incurved and a little stronger than in forewing; RS and M1, M3 and C2 are from the angles and not stalked; otherwise the venation is similar to that of the previous species.

Male genitalia: abdomen without basal coremata; uncus similar to *argentivitta* but apical half tapering more evenly; tergite tapering to a point, broadest at middle, moderately chitinated, fringed with long hairs posteriorly; sternite narrow, well chitinated, ending in a moderate saccus; anus slightly chitinated below at base; valve of almost even width, slightly wider at apex, termen oblique, straight and with a corona of stout bristles; terminal half of valve, except along costa, weakly chitinated, well covered on inner side with moderate hair, on outer side with long hair and hair like scales mixed; saccus moderately long, well chitinated and with a very broad rounded clavus, which has an irregular surface and short hairs along the edge; a short, rather weakly chitinated harpe from well beyond saccus and from well above inner margin, where the inner margin is strongly chitinated; harpe slightly contracted at middle, rounded at tip and just reaching costa; a fairly well chitinated ridge from base of harpe and one from basal portion of costa, which join well beyond middle of valve, forming a rather long curved lobe, projecting beyond inner margin (this additional lobe I have not found in the other three species); ædæagus rather stout, well chitinated, terminating in a rather broad lobe, which is finely granulated and gradually merges into the vesica; vesica with three lobes, each provided with a cornutus; one cornutus very short and not broadly based, the second about twice as long, much stouter and broadly based, the third about twice as long as the second, stouter and broadly based; between these lobes the vesica has a broad, curved, well chitinated patch, beset with minute teeth and terminating in a long rather broad and solid looking chitinated object, densely beset with strong teeth (this may almost be considered a cornutus but, in the two preparations made, I did not succeed in evaginating it from the vesica, as it seemed to adhere over the whole surface to the vesica); an additional long lobe without cornutus (this is not shown in the figure, because I did not succeed in evaginating it, but it is clearly visible within the base of the vesica and seems to be finely granulated).

Exp. 38—41 mm. *Hab.* Type from Estcourt; also recorded

from Durban and German East Africa; in my collection from Thabanchu, Umkomaas, Durban, Waterval Onder, Pretoria; II.—IV., XI., XII.

***Empusada pallidistria* Feld. (Fig. 3; pl. IV. 10.)**

Cucullia pallidistria Feld., Reise Nov. pl. 108, f. 54 (1874).

Empusada pallidistria Hmps., Cat. Lep. Phal. VI. p. 88, pl. XCVIII .f. 18 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58, pl. 7 (1934).

Venation similar to that of *chrysota*.

Male genitalia: base of abdomen with lateral coremata covered with very long hair hidden in lateral pockets; uncus very stout, heavily chitinised and longer than in the other three species, strongly curved at basal third, then slightly curved and gradually tapering to a fine curved point, short bristly hairs on upper side; tergite rather broad, but somewhat short, moderately chitinised, heavily so along anterior edge, posterior edge fringed with long hairlike scales most of which are bifid at tip; sternite narrow, ending in a rather broad saccus, well chitinised; anus strigulated and granulated on the strigulae over most of their lengths and apparently moderately chitinised, but it did not take any stain; valve of almost even width but suddenly broadening towards apex, where the costa is upturned; termen very oblique, arched and with a corona of broad, closely fitting bristles, some curved bristly hairs on outer side of termen and a few similar bristles on outer margin; basal portion of valve before middle moderately chitinised, remainder of valve except costal area rather membranous, covered on inner and outer side with long hairs; sacculus about one-third of valve, well chitinised and with a rather long and broad well chitinised clavus; immediately beyond the sacculus and a little above the inner margin a well chitinised harpe of even width, slightly curved, just projecting beyond costa and acuminate at tip; aedeagus rather short and rather weakly chitinised, connected terminally to the vesica by means of two broad lobes, one of which is well chitinised, the other less so but punctulated; vesica with two short lobes, each with a cornutus, both of which have a tubular broad base, which is heavily chitinised and gradually merges into the vesica; one cornutus is about half the length of the other (both unfortunately had the tips broken off in the preparation); another rather short lobe has a chitinised broad patch which seems to be double and joined up at base so as to become somewhat boat-shaped, partly covered with short teeth, then it becomes wider, less chitinised, more densely beset with teeth and curved (this structure is probably homologous to the one described in *chrysota* and is feebly developed in the other two species); in

addition a much longer lobe, densely beset with minute teeth over the terminal half.

Exp. 41—48 mm. *Hab.* Type from South Africa (without precise locality); also recorded from Kokstad and Maseru; in my collection from Harrismith, Noordkaap (Barberton District) and Johannesburg, collected in April.

***Empusada pyrostroma* Hmps.**

Empusada pyrostroma Hmps., Cat. Lep. Phal. VI. p. 88, pl. XCVIII. f. 15 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58, pl. 7 (1934).

Exp. 42 mm. *Hab.* Johannesburg; so far only the female type is known.

I have not come across this species yet. According to the description and the figure it resembles *chrysota*, but is distinguished from it by a black streak on the lower median and a slight black streak above inner margin before middle.

NEOCUCULLIA gen. nov. (Fig. 3.)

Type *albisignata* spec. nov.

Palpi as in *Cucullia*, somewhat more porrect; proboscis well developed; frons less bulging than in *Cucullia* and with a slight ridge above proboscis; frons and vertex covered with long spreading scales; antennae in male simple, first joint tufted with scales in front and above; tegulae forming a distinct but short hood, mainly covered with scales; patagia with long hair-like scales and hairs mixed; metathorax with a short crest; basal segment of abdomen with a crest, second and third segment without a crest; abdomen covered with scales; foretibia without a claw; all tibiae fringed posteriorly with long spreading hairlike scales and hairs mixed; hindtibia with four spurs, middle spurs a little longer than terminal spurs, outer spur about half of inner; tarsi with three parallel rows of spines on inner side. *Forewing*: shorter and broader and with termen less oblique than in *Cucullia*; costa almost straight, arched towards rounded apex; termen slightly arched between M1 and C2 and slightly crenulated; tornus well rounded; inner margin straight, except for a slight bulge before middle; cell a little over half of wing; venation as in *Cucullia*, but R5 from end of areole (this, however, is frequently found in other species of *Cucullia*); M1 remote from areole; upper DC less incurved than in *Cucullia* and C2 a little nearer to lower angle. *Hindwing*: shorter than in *Cucullia* and termen more arched; cell a little over half of wing; costa somewhat arched at middle; termen slightly crenulate; inner margin slightly bulging at A3; Sc upcurved at base, then downcurved and anastomosing with upper median for a short distance, thus forming

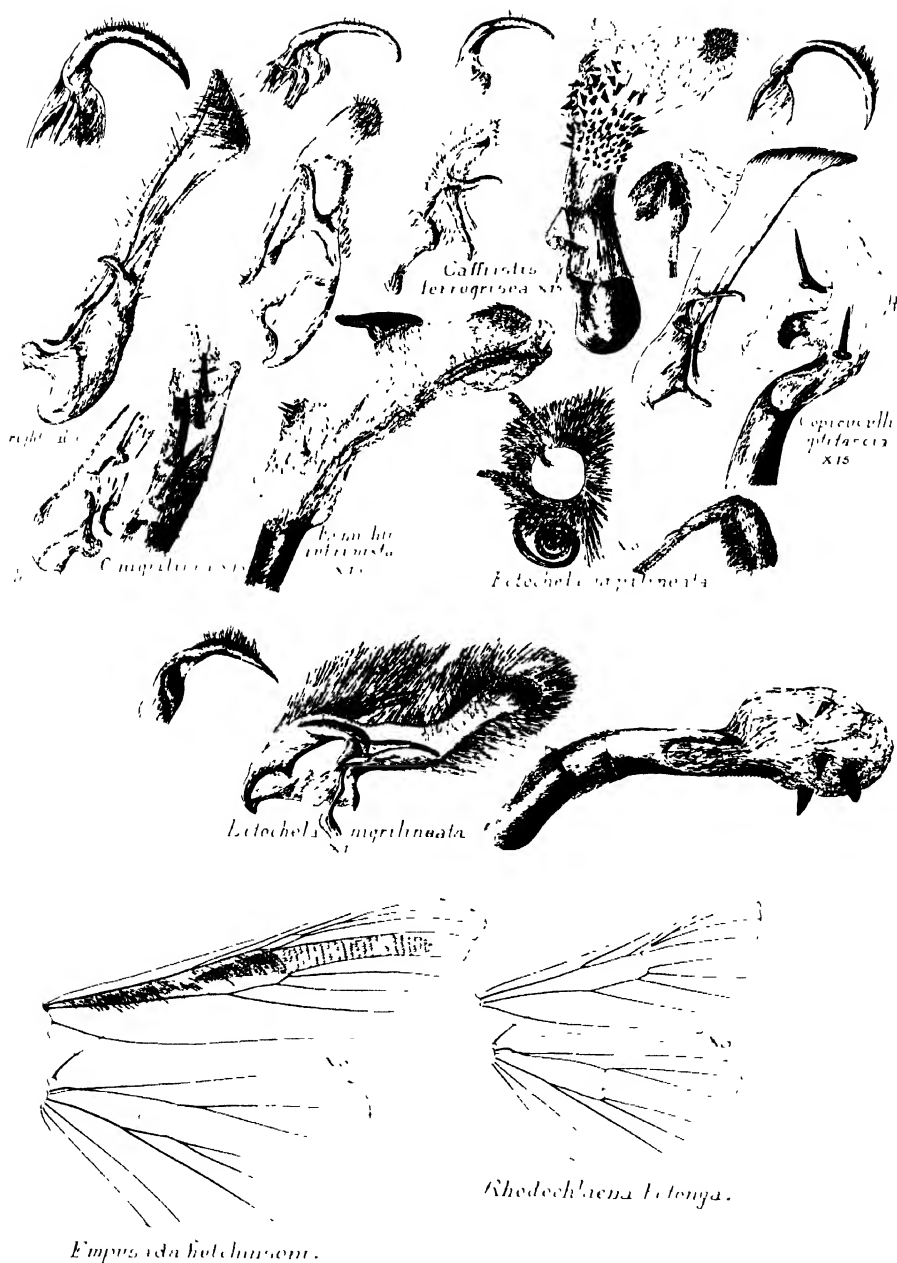


Fig. 4. Uncus, valve and penis of *Cucullia nigrilinea*, *Eumichtis rubrimixta*, *Cafristis ferrogrisea*, *Copiacucullia ruptifascia* (also with fore tibia), *Ectocheila nigrilineata* (also head and fore tibia); wing venation of *Empusada hutchinsoni* and *Rhodochlaxa botonga*.

a basal areole, then straight, slightly curving towards tip; RS and M1 from upper angle; M2 very weak but still visible and from about three-fourths of DC; upper DC incurved, weak; C1 a little more remote from M3 than M2 is; C2 from before two-thirds of lower median; A2 and A3 almost straight.

Male genitalia: abdomen without hair pencils at base; uncus stout, strongly curved, broadest at terminal half and obliquely rounded at tip; from middle of upper side a sharply pointed, somewhat curved process, as thick as the uncus itself; long dense hairs along the sides, shorter ones on upper side of terminal half, still shorter ones on under side; tergite rather broad, well chitinised, especially anteriorly, posterior edge fringed with hair-like scales; sternite well chitinised, rather long and curved, gradually forming a short saccus; under side of anus slightly chitinised; valve irregular at costa and inner margin, basal two-thirds rather broad and well chitinised, then suddenly contracted, making terminal third rather narrow and with the upper and lower edge nearly parallel, termen oblique and with a slight corona; this terminal third is weakly chitinised, covered on upper outer side with a series of broad scales, which seem to be somewhat chitinised and hollow, as they retain air (possibly this is part of the corona), remainder of outer side densely covered with long hair-like scales; sacculus forming nearly one-third of valve in length but less broad and provided with a long well chitinised clavus, which has a flattened terminal lobe pointing outwardly; inner marginal area beyond sacculus broadly chitinised and from two-thirds of this originates a broad, rather flattened, well chitinised harpe, which is of somewhat different shape in right and left valve, as indicated in the illustration; costa very broadly chitinised, somewhat produced beyond middle, covered with long hairs on inner side and contracted to an erect process, continued a little beyond the less chitinised terminal part of valve; ædæagus rather long, almost straight, basal portion slightly thicker, terminally ending in a broad heavily chitinised lobe, which is provided with three rows of short teeth; another narrow long lobe, continued over the greater length of the vesica and articulated to the large cornutus, heavily chitinised and densely covered on outer side with minute teeth; vesica with four sharply pointed closely situated cornuti, at tip a very broad, long, heavily chitinised, flat cornutus, which appears to have the outer edges curved backwards in opposite directions over nearly the whole length.

This genus, though closely allied according to the venation to *Cucullia*, has totally different male genitalia; the peculiar structure of the uncus is not found in any of the *Cuculliids*; a similar tooth-like projection on upper side of uncus that resembles the one of this genus is only found by me in *Ramesodes divisa*, but

is there much shorter, and in *Caradrina melanospila*, where it is minute. Only one species in this genus.

***Neocucullia albisignata* spec. nov. (Fig. 3; pl. VI. 1, 5.)**

Head, thorax and forewing hair brown, more or less irrorated with fuscous-black; palpi well irrorated with black; frons with a transverse ridge of black scales; tufts of fuscous scales between antennæ; at base of tegulæ a broad black fascia; crest on metathorax well irrorated with black; thoracic crest hair brown, irrorated with black; abdomen drab, well irrorated with fuscous; underside and hairs on legs hair brown; hindwing white. *Forewing*: a few black scales at costa, representing the subbasal; antemedial beginning at costa as a rather broad diffused black fascia, oblique towards orbicular, then as a narrow well defined line from lower median, strongly outwardly dentate on inner marginal fold, then slightly dentate below A2; before it at costa a small diffused black macula, below this in cell a narrow V-shaped mark, followed by a diffused black semicircular line, space in cell before the V-shaped mark and before the antemedial irrorated with white scales; immediately below this a well defined black striga on inner marginal fold from base to just before the antemedial; orbicular large, round, defined on upper and inner side by a narrow black line, joining the antemedial and continued as a curved black line well below lower median to beyond origin of M3, slightly dentate on C1, centre of orbicular and greater part of reniform wood brown; reniform only indicated on upper side by a narrow black curved line with a long macula at costa before it and touching the orbicular; immediately beyond this a small black macula at costa, being the origin of an ill-defined pale postmedial line, which is excurved from R2 to C2 and slightly defined on inner side by a hair brown line, which becomes a broad black lunule beyond C2; this lunule has a black fascia before it in inner marginal fold, which connects it to the large tooth of the antemedial line; immediately beyond the lunule a conspicuous white lunulated macula; below this the postmedial is as above the white mark; immediately beyond this a black fascia below C2, nearly reaching termen, continued above C2, reaching termen, where it merges with the terminal lunule; above C1 a similar fascia, but not quite as long; veins R1 to M3 lined with black, interrupted by a hair brown clouding where the subterminal line should be; all other veins, including A2, black, irrorated with pale grey; a terminal series of narrow black lunules between the veins; cilia hair brown, basal half slightly darker and with a very narrow pale basal line. *Hindwing*: most of the veins irrorated with drab and with an elongated cell-spot shining through from the underside; a broad terminal border of a drab irroration diffused on inner side; cilia whitish, terminally but irregularly sprinkled

with drab. *Underside*: forewing, except inner marginal area which remains bluish white, densely irrorated with hair brown; hindwing slightly irrorated with hair brown on costal area and terminal border, densely so at end of cell, forming the cell-spot, a broad postmedial irrorated line.

Exp. Male Type 35 mm.; female type and cotype 38 mm. *Hab.* male type from Durban, 25th February 1919 (E. L. Clark); female type from Bethlehem (Orange Free State), (v. d. Merwe), 6th March 1918; female cotype from Rietvlei (Natal), (van Otto), January 1918.

Genus COPICUCULLIA Smith (Fig. 4.)

Copicucullia Smith, Tr. Am. Ent. Soc. XXI. p. 84 (1894); Hmpsn., Cat. Lep. Phal. vi. p. 9 (1906); Gaede, Seitz Gross-Schmett. XV. p. 5 (1934).

Type, *eulepis*, from N. America.

Description from *ruptifascia*.

This genus differs from *Cucullia* in the slightly more upturned palpi and a claw at the end of the foretibia; the venation of both wings is practically the same as in *Cucullia* and so is the shape of the wings.

Malegenitalia: a pair of lateral hair brushes, partly hidden in pockets at base of abdomen; uncus stout, slightly thicker at one-third, then tapering to a fine point, basal half strongly curved, terminal half less so, moderate hairs on upper side; tergite moderately chitinated, suddenly narrowing at basal third, fringed posteriorly with long hair-like scales; sternite narrow, well chitinated, ending in a short saccus; valve rather narrow, of almost even width, broadening at tip, apex very much produced, a corona composed of closely situated bristles along termen, basal third of valve and area along costa moderately chitinated, remainder less so; inner side of valve sparsely covered with long hairs, more densely near termen, outer side covered with long bifid hair-like scales and with short curved scales along terminal area, simple hair-like scales along inner margin; sacculus rather short, provided with a rather long narrow clavus; well beyond sacculus and remote from inner margin a well chitinated rather flat harpe, curved at tip and there covered with short hairs and projecting for nearly half its length beyond costa; ædæagus moderately stout, well chitinated, slightly curved beyond middle, terminating in a flat lobe, which is finely punctulated and gradually merges into vesica; vesica with two lobes, each terminating in a stout, broadly based, finely pointed cornutus; between them, at base of another short lobe, a roundly pointed chitinated patch, covered on outer side with short teeth; another long terminal lobe finely punctulated for the greater part.

A small genus; six representatives in North America; one from Algeria, two from Western Asia and one from South Africa.

***Copicucullia ruptifascia* Hmps. (Fig. 4; pl. V. 12.)**

Copicucullia ruptifascia Hmps., A.M.N.H., 8, IV. p. 384 (1909); Gaede, Seitz Gross-Schmett. XV. p. 55 (1934).

Exp. 34 mm. *Hab.* type from White River. In my collection from Thabanchu, Bloemfontein, Bultfontein, Pretoria and Bulawayo; I.—III., X.—XII.

This species may readily be confused with *Cucullia consimilis*, but is most easily distinguished from this by the claw on the foretibia and the more even bluish colour of the forewing.

Genus RHODOCHLAENA Hmps. (Figs. 3, 4,)

Rhodochlaena Hmps., Cat. Lep. Phal. VI. p. 131 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58 (1934).

Type, *botonga*.

Proboscis rudimentary; palpi obliquely upturned, third joint porrect, loosely covered with hair-like scales and hairs mixed, somewhat fringed in front of first and second joint, second joint about twice first joint, third joint about one-fourth of second joint and less densely covered; eye rounded and with a few overhanging hairs, which are so short that they may belong to the hairs of the frons (if that is so, this genus should come in the *Acronictini* and I have little doubt that this would be more correct, the shape of the wing, the absence of a hood and the structure of the genitalia point to this); frons rounded, loosely covered with long hair-like scales; scales on vertex broader and shorter, but also loosely placed; antennæ in male bipectinate, serrate in female, longest pectination over twice shaft, gradually diminishing in length towards tip; first joint of antennæ with a short frontal tuft; thorax, tegulae and patagia rather loosely covered with long scales; tegulae not forming a hood; metathorax with a broad central crest; abdomen without any crests, but with some hairs on the first two basal segments, otherwise covered with appressed scales; femora and tibiae covered with scales, posteriorly fringed with hairs; foretibia without a claw; hindtibia with four spurs; outer spur a little longer than half of inner spur. Forewing: rather broad, subtriangular, termen almost erect and slightly crenulated, costa straight, apex and tornus rounded, inner margin slightly arched near base; cell well over half of wing; R1 from well beyond middle of upper median; R2 and R3 stalked for one-fourth of R2 and from three-fourths origin of R1 and upper angle; R4 and R5 stalked for less than one sixth of R5; R3 anastomosing a little beyond its stalk for one-third of its free length with the free part of R4, thus forming a moderate, narrow areole; M1 well remote from

areole; upper DC obsolescent; M2 from one-fourth of DC; C1 nearly twice as far from M3 as M2 is; C2 from two-thirds lower median; A2 simple at base, slightly curved. *Hindwing*: subtriangular, with costa arched at base and before apex, termen well arched, somewhat crenulate, inner margin strongly arched, apex and tornus rounded; cell a little less than half of wing; Sc anastomosing for a short distance and a little beyond base with the upper median, thus forming a small basal cell; RS and M1 very shortly stalked; M2 very weak but present and from one-third of DC; DC almost straight, upper DC obsolescent; C1 a little remote from M3; C2 from a little beyond middle of lower median; A2 and A3 almost straight.

Male genitalia: abdomen without coremata at base; uncus stout, broadest at middle, tapering to a fine point, well curved near base, slightly so along terminal two-thirds, upperside with short hairs; tergite rather narrow but somewhat lobate posteriorly immediately below uncus, rather weakly chitinised; sternite very narrow, short and weakly chitinised, terminating in a broad, rather long, rounded saccus; anus very slightly chitinised below at middle; valve rather short, gradually tapering towards the broadly rounded tip, where there are along the edge some isolated bristles but no real corona; most of the valve weakly chitinised, covered on inner side by rather short papillated hairs, on outer side with longer hairs and scales mixed; sacculus rather small, weakly chitinised and *without a clavus* (this also may be an indication that it is not a true *Cuculliid*); from base of sacculus a rather long, well chitinised process connected to base of harpe, which has another short process connecting the harpe to the costa, where the latter is moderately chitinised; harpe rather flat, of almost even width, terminating in a point, somewhat curved inwardly and not extending beyond the valve; ædæagus rather weakly chitinised, of almost even width, slightly curved at middle and with isolated short spines along its outer edge and partly fixed on the vesica; vesica tubular with a slightly chitinised ridge at middle and with a central spiral tube, which is finely punctulated (it is possible that this spiral tube is fully extended when copulation takes place).

Only one species is placed here from South Africa and another one from the Congo.

***Rhodochlæna botonga* Feld. (Figs. 3, 4; pl. IV. 11.)**

Dianthæcia botonga Feld., Reise Nov. pl. 109, f. 28 (1874).

Rhodochlæna botonga Hmps., Cat. Lep. Phal. VI. p. 131, fig. 36 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58, pl. 7 (1934).

Heliophobus perrubra Hmps., Ann. S. A. Mus. II. p. 279 (1902).

Exp. 31—33 mm. *Hab.* Male type from Knysna, female type of

perrubra from Transkei. In my collection from Stellenbosch and Krantzklouf; III., X.

Genus **LEUCOCHLÆNA** Hmps. (Fig. 2.)

Leucochlæna Hmps., Cat. Lep. Phal. VI. p. 132 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58 (1934).

Type, *oditis* = *hispida* from Europe ¹⁾.

Description from *leucogonia*.

Proboscis rudimentary; palpi porrect, not projecting beyond hairs of frons, covered with loosely fitting hair-like scales and hairs mixed, second joint a little longer than first joint, third joint very small, hidden in the hairs; frons smooth, covered with long tufted hair-like scales and hairs mixed, extended over vertex; eyes large, suboval and with some overhanging hairs, which I really think belong to the covering of the frons; antennæ of male shortly bipectinate, in ♀ simple; longest pectination a little over diameter of shaft, gradually diminishing towards tip in length; tegulæ and patagia covered with long usually bifid hairs, without forming a hood; metathorax somewhat tufted with long hair-like scales (the prothorax is supposed to have a crest, but I fail to find it); abdomen without a distinct crest but, apart from the scaly covering, long hairs on upper side, especially towards base; a series of lateral tufts on abdomen, mainly composed of scales; femora and tibiæ densely tufted with hair-like scales and hairs mixed; foretibia without a claw; hindtibia with four spurs; outer spur over half of inner. *Forewing*: shape and venation similar to that of *Rhodochlæna* but termen a little more oblique and less crenulated, areole a little longer, M1 more remote from areole and C1 more remote from M3. *Hindwing*: as in *Rhodochlæna* but termen less crenulated; R.S. and M1 remote, M2 remote from M3 and C1 a little closer to M3.

Male genitalia: abdomen without coremata; uncus very stout, rather short, broadest before middle, tapering towards the rather blunt tip, curved near base, then almost straight and without hairs on upper side; tergite of almost even width, moderately chitinated, except along anterior margin, posterior margin undulating, forming two small lobes and densely fringed with very long hair; sternite narrow, only broader at base, where it forms a short saccus; valve rather short, broadest at basal half, somewhat contracted beyond middle, broadly rounded at tip, where there is a narrow area covered with rather long bristly hairs; terminal half of valve rather weakly chitinated, covered on inner side with short hairs, densely so on outer side with long hairs and hair-like scales; sacculus

¹⁾ The type of this genus is not *fullax*, as given by Gaede (l. c. p. 58) for Hampson in the original description definitely designates *hispida* as the type.

rather short and rounded, without a clavus; harpe very broad at base and long, tapering to a somewhat blunt point, curved inwardly at middle but remaining within the area of the valve; its base has two short branches, one connecting it to base of sacculus, the other to base of costa; ædæagus rather short, stout, weakly chitinised; vesica subglobular, with two minute broadly based thorn-like cornuti.

The remark made under *Rhodochlæna* as regards its tribal position also holds here; it is probably better placed in the *Acronicti*. I am not even sure that *leucogonia* is properly placed here for the description and figure given of the genotype by Pierce do not quite support the inclusion of the South African species. According to him the harpe is placed differently and the vesica has six or seven cornuti united at the base and in addition a small bulbous cornutus. A more detailed study of all the species placed in this genus is essential in order to come to a definite conclusion.

In addition to the South African species two species are placed here from the Palæarctic region, one from Algeria, one from Kashmir and one from Mexico.

***Leucochlæna leucogonia* (Hmps. (Fig. 2; pl. IV. 12.)**

Heliophobus leucogonia Hmps., Ann. S. A. Mus. III. p. 426 (1905).

Leucochlæna leucogonia Hmps., Cat. Lep. Phal. VI. p. 136, fig. 39 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58, pl. 7 (1938) as synonym of *Noctua trinota* H.-S. Lep. Exot. f 126.

Gaede sinks *leucogonia* as a synonym of *trinota* H.-S., which, according to Walker (Cat. IX. p. 158), is from the Cape, but Gaede only mentions Mashonaland and Natal as the locality of this species, which agrees with the localities given by Hampson. As I do not possess Herrich-Schaeffer's work I cannot possibly verify whether Gaede is correct, so I provisionally keep to the name given by Hampson. Curiously the name *trinota* H.-S. is not to be found in any of the volumes of Hampson's catalogues.

Exp. 24—46 mm. *Hab.* Type from Mashonaland; also recorded from Krantzklouf. In my collection from Emjanyana, Umtata, Umkomaas, Durban, Empangeni, Nkandhla Forest, Sarnia, Krantzklouf, Modderpoort, Mahuba's Kloof; I.—IV., XII.

Genus ULOCHLÆNA (Fig. 3.)

Ulochlæna Led., Noct. Eur. p. 96 (1857); Hmps., Cat. Lep. Phal. VI. p. 137 (1906); Gaede, Seitz Gross-Schmett. XV. p. 58 (1934).

Type: *hirta*, from Europe.

Description from *fumea*.

Proboscis absent; palpi oblique, third joint porrect, scarcely reaching beyond frons, second joint about one and a half times first joint, third joint about half of first joint, almost hidden in hairs, all joints covered with loose scales, first and second joint fringed with very long hair; frons smooth, covered with some scales and woolly hair mixed; vertex covered with long hairs; antennæ of male biserrate and shortly bi-fasciculated; eyes large, rounded, covered with some spreading eyelashes, which may however originate from the frontal hair-covering; tegulæ, patagia and thorax covered with long hairs and hair-like scales, which are very loosely placed; thorax without crests and without hood; abdomen without crest, covered with scales and with some long hairs on upper side, densely so at base; foretibia without a claw; all tibiæ and femora covered with scales and fringed on outer side with long hairs; hindtibia with four spurs; outer spur a little shorter than inner spur, which is very long; thorax on underside densely covered with hair. *Forewing*: subtriangular, with costa slightly incurved, termen somewhat oblique and slightly arched at middle, inner margin arched at basal half, apex and tornus well rounded, cell well over half of wing; R1 from just beyond middle of upper median; R2 and R3 on a stalk of one-fourth of R2 and from two-thirds of origin of R1 and upper angle; R4 and R5 on a stalk of one-seventh of R5; R3 anastomosing with half the stalk of R4—R5 and with one-third of free part of R4, thus forming a rather long narrow areole; M1 from areole; M2 from less than one-fourth of DC; upper DC strongly angled inwardly at submedian fold and rather weak; C1 from M3 as far as M2 is; C2 from two-thirds of lower median; A2 simple at base but somewhat curved. *Hindwing*: semicircular, with costa almost straight but arched at base and apex, termen very oblique, well arched, and gradually merging into the well rounded tornus, inner margin well arched, apex roundly pointed; cell a little over half of wing; Sc anastomosing for a short distance with upper median well beyond base, thus forming a long narrow basal cell; RS and M1 very shortly stalked; M2 weak but present and from about one-third of DC; upper DC rather weak and sharply angled in submedian fold; M3 and C1 from upper angle; C2 from two-thirds of lower median; A2 and A3 almost straight.

Male genitalia: base of abdomen without coremata; uncus rather broad at base, tapering to a point, basal half strongly curved, terminal half less so, upper side densely covered with hair; tergite rather narrow at upper half, roundly bulging at lower half and provided posteriorly with a subtriangular lobe fringed with long hair, the whole tergite and uncus are weakly chitinised; sternite better chitinised, moderately broad, ending in a broad saccus; anus not chitinised; valve with basal two-thirds moderately broad, moderately

chitinised, with costa strongly arched, inner margin and part of termen almost parallel to it; the chitinised costa suddenly ends and becomes somewhat produced at two-thirds and the remaining third of valve becomes suddenly contracted, the upper and lower margin then remain parallel and form a round apex, the costal margin is somewhat incurved, the terminal margin excurved; terminal part of the valve hardly chitinised, covered on inner side with rather long papillated hairs and shorter but more crowded hairs towards tip, but without corona, outerside covered with very long hair, at tip with curved scales; sacculus about half width of valve and extending from base to tornus, but without a clavus; innermargin beyond it with some bristly hairs; well below costa, and parallel to it, a well chitinised ridge reaching from base to costal lobe; just before this lobe a short roundly pointed process, directed inwardly (this probably represents the harpe) and immediately below it a narrow less chitinised process, connecting it to tornus; ædæagus stout, thickest at basal half, weakly chitinised but becoming more chitinised at tip on lower side; vesica very small, subglobular and with two broadly based, stout cornuti, of which one is about two-thirds of the other in length.

Of the seven species placed in this genus, the genotype is from the Mediterranean Region; one is from Algeria and Tunis only, and one other occurs in Tibet, of which Hampson remarks that it suggests an Agrotid genus. Of the four South African species placed here by Gaede, *schaeferi* is certainly wrongly placed, if my identification is correct (which I hardly doubt, seeing that the wings are very clearly marked) for the foretibia has a distinct claw. These four species may be distinguished as follows:

- | | | |
|-----|--|---------------------|
| 1a. | Forewing with one or two pale maculæ | 2 |
| b. | Forewing without pale maculæ | 3 |
| 2a. | Forewing with a white macula in cell, connecting the white orbicular and reniform | <i>schaeferi</i> . |
| b. | Forewing with a small yellowish white macula across C1 and a larger macula from C2—M2 | <i>ferruginea</i> . |
| 3a. | Forewing with the antemedial and postmedial lines strongly dentated; hindwing tinged with brown | <i>sagitta</i> . |
| b. | Forewing with the antemedial and postmedial lines not strongly dentated; hindwing pale brownish grey | <i>fumea</i> . |

***Ulochlæna fumea* Hmps. (Fig. 3; pl. IV. 13.)**

Heliophobus fumea Hmps., Ann. S. A. Mus. II. p. 280 (1902).

Ulochlæna fumea Hmps., Cat. Lep. Phal. VI. p. 140, fig. 42 (1906); Gaede, Seitz Gross-Schmett. XV. p. 59, pl. 7 (1934).

Exp. 20—32 mm. *Hab.* Type from Transkei: In my collection from Impetyeni Forest (Natal); VIII., IX.

***Ulochlæna schaeferi* Gaede.**

Ulochlæna schaeferi Gaede, D. ent. Zs. Iris, 29. pp. 101—123 (1915); Gaede, Seitz Gross-Schmett., XV. p. 59, pl. 7 (1934.)

A female specimen in the collection of the Transvaal Museum agrees in every respect with the description and figure given by Gaede, except that the hindwing of this specimen for the terminal half is suffused with hair brown, but the figure represents a male and in the description the darker hindwing of the female is mentioned; as the marking of the forewing is very characteristic I do not think there is any doubt about the correct identification, but the specimen before me has a distinct claw on the foretibia and it has the distinctive fringe of scales overhanging the eyes, as mentioned in this paper on p. 11A, moreover the palpi are quite different from those of *fumea*, the third joint being very long and having a knob-like thickening at the tip. I have no doubt that this species is better placed in *Centrarthra*, but as I have no male, I cannot fully prove this.

Exp. 28—30 mm. *Hab.* South West Africa. In Transvaal Museum, one specimen from Luederitz Bay in April.

Species auctorum.

***Ulochlæna reducta* Gaede.**

Ulochlæna reducta Gaede, D. Ent. Zs. Iris, 29, pp. 101—123 (1915); ¹⁾ Gaede, Seitz Gross-Schmett. XV., p. 59 (1934).

This is probably a reduced form of *schaeferi*.

***Ulochlæna sagitta* Gaede.**

Ulochlæna sagitta Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915); Gaede, Seitz Gross-Schmett. XV. p. 59, pl. 7 (1934).

Exp. 29 mm. *Hab.* South West Africa.

***Ulochlæna ferruginea* Gaede.**

Ulochlæna ferruginea Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915). Gaede, Seitz Gross-Schmett. XV. p. 59 (1934).

Exp. 26 mm. *Hab.* South West Africa.

Genus CHARIDEA Guen. (Fig. 3.)

Charidea Guen., Noct. II. p. 60 (1852); Hmps., Cat. Lep. Phal.

¹⁾ As I have not been able to consult Gaede's paper in "Iris", I have been unable to ascertain the pagination for each of these species. (see also *Ectocheila*).

VI. p. 140 (1906); Gaede, Seitz Gross-Schmett. XV. p. 59 (1934).

Type: *elegantissima*.

Proboscis well developed; palpi obliquely upturned, third joint a little more porrect, reaching well above frons; second and third joint of almost even length, covered with appressed scales and fringed with long hair in front; third joint with appressed scales only; frons smooth, covered with hairs and hair-like scales mixed and forming a transverse ridge immediately before the antennæ; eyes suboval, large and with distinct overhanging cilia; antennæ of male bipectinate; longest pectination nearly three times shaft, gradually getting shorter to before tip; first joint of antennæ with a scale tuft mixed with hair in front and on upper side; vertex and thorax loosely covered with scales, mixed with hair-like scales; prothorax and metathorax with spreading crests; tegulæ not hooded but somewhat raised; abdomen with a basal crest on upper side and laterally fringed with hair; legs covered with long scales, tibiæ and femora fringed posteriorly with long hairs, forming a spreading tuft on the femora; foretibia without a claw; hindtibia with four spurs; outer spur about two-thirds of inner. *Forewing*: in shape and venation similar to *Rhodochlæna* but termen a little more oblique and areole much longer, about six times longer than its width. *Hindwing*: similar to *Rhodochlæna*, RS and M1 also very shortly stalked.

Male genitalia: abdomen without lateral coremata at base; uncus rather short, stout, tapering towards the slightly curved tip, strongly curved at base, then straight; tergite rather weakly chitinised, short and moderately broad, fringed with hair-like scales posteriorly, sternite better chitinised and longer than tergite, broadening towards base; anus somewhat chitinised ventrally; valve of almost even width for two-thirds of its length, then suddenly narrowing with a rounded curve to less than half its width, then roundly ending at termen; at end of broadest portion two remote, stout and long bristles, each situated on the somewhat raised margin; some bristles and a minute corona of short bristles on edge of apex; innerside of valve sparsely covered with hairs, outerside well covered with hair-like scales; most of the valve moderately chitinised, more strongly so along the somewhat incurved costa; sacculus rather narrow and weakly chitinised; from middle of valve a broadly based harpe, tapering towards tip, somewhat curved beyond middle and just projecting beyond the costa; ædæagus rather weakly chitinised, most strongly towards tip; vesica with an elongated ridge, beginning near ædæagus, covered with short spines; two broad patches towards tip, densely covered with similar short spines; terminal half of vesica densely covered with minute spines.

Only one species in this genus.

Charidea elegantissima Guen. (Fig. 3; pl. V. 1.)

Charidea elegantissima Guen., Noct. II. p. 61, pl. 8, f. 12 (1852); Hmps. n., Cat. Lep. Phal VI. p. 141, fig. 43 (1906); Gaede, Seitz Gross-Schmett XV. p. 59, pl. 7 (1934).

Exp. 34—40 mm. *Hab.* Type from the Cape of Good Hope; also recorded from Grahamstown and Portuguese East Africa. In my collection from Cape Colony without precise locality but probably from Cape Town.

Genus ECTOCHELA Hmps. n. (Fig. 4.)

Ectocheila Hmps. n., Ann. S. A. Mus. II. p. 279 (1902); Gaede, Seitz Gross-Schmett XV. p. 59 (1934).

Type, *canina* Feld.

Description from *nigrilineata* Gaede.

Proboscis very well developed; palpi obliquely upturned, third joint somewhat porrect, reaching a little beyond frons; first and second joint of almost even length, covered with somewhat appressed scales and fringed with scales and hair-like scales in front; frons smooth, covered with long curved hair-like scales, which meet each other from either side, thus forming a slight ridge and with a tuft of long scales immediately before the antennæ; on either side of this a tuft of curved scales overhanging the middle of the eyes; ¹⁾ vertex loosely tufted with long scales; antennæ of male bifasciculated, of ♀ very shortly ciliated; thorax covered with scales and hair-like scales mixed (Hampson mentions spreading crests on pro- and metathorax,

¹⁾ This tuft should not be confused with the overhanging cilia found in the typical *Cucullids* for it is composed of scales which do not spread but stand up, forming a narrow tuft placed vertically to the surface of the eyes and almost reaching the centre of it. For this and other reasons to follow I think this genus is really wrongly placed in the *Cucullia*, perhaps this genus is even identical with *Centrarthra*. I think all the species placed by Gaede and Hampson in *Ectocheila*, will ultimately prove to be *Centrarthra*. The following species placed in *Centrarthra* have no tuft overhanging the eye: *albapicata*, *albogrisea*, *albomaculata*, *brevipunctata*, *brunnea*, *fulvipes*, *fulvitincta*, *fulvicincta*, *griseola*, *hercystigma*, *nigrosignata*, *pygmaea*, *serriicornis*, *similis* and *vansoni*. The following species, however, have a tuft just as in *nigrilineata*: *albipuncta*, *albistriga*, *argentea*, *cretacea* (tuft very short), *dicksoni*, *modesta*, *monochroma*, *ochrealis*, *ossicolor* and *pallidescens*. In *C. dentata* and *C. diffusa* the tuft is a spreading one, but it may be that the overhanging hairs are actually lateral frontal hairs, not corresponding to the typical eyelashes; in *C. pectinata* there are (in the only specimen I have), scales which lie over the eyes, but these may be frontal scales displaced in relaxing.

Considering all these points, and those presented by the male genitalia, I consider this genus not to be a typical *Cucullid* but nearer to *Centrarthra* if not identical with it.

For descriptions of the species of *Centrarthra* see Janse "Moths of South Africa" volume III pp. 169.—188.

but I fail to find these in my well preserved specimens; the mesothorax, however, has the long hair-like scales converging to the centre, so as to overhang the metathorax and the metathorax has, just beyond base of hindwings, a lateral pencil of long spreading hairs overhanging the base of the abdomen); abdomen without crests, clothed with scales mixed with rather long hair and with lateral hair tufts; femora and tibiae covered with long scales and fringed posteriorly with long hairs; foretibia with a terminal claw pointing outwardly; hindtibia with four spurs, outer spur about half of inner; tarsi with three rows of strong spines. *Forewing*: shape and venation as in *Rhodochlæna* but termen a little more oblique, areole a little wider and R5 a little more remote from the anastomosis of R3 and R4. *Hindwing*: shape as in *Rhodochlæna*, but RS and M1 from a point, M2 more obsolescent and from near middle of DC, M3 and C1 a little closer together.

Male genitalia: base of abdomen without lateral coremata; uncus stout, well chitinised, evenly tapering to a fine slightly curved point, somewhat curved before basal half, then straight and tufted with hair above; tergite well chitinised, moderately broad, tufted posteriorly at base with moderate hairs; sternite narrow, well chitinised, ending in a short saccus; anus slightly chitinised ventrally; valve broad at base, suddenly narrowing at one-fourth and undulating, rounded terminally, apical area densely covered with many rows of spines, terminal two-thirds rather weakly chitinised except along costa, inner side sparsely covered with hair, outer side densely covered and fringed with long hairs and hair-like scales; sacculus rather short, well chitinised, and forming a pointed lobe at upper half (this, however, I do not think homologous to the clavus, typically present in the *Cuculliids*); from one-third of valve a strongly chitinised somewhat curved harpe, which tapers to a blunt point and is directed to, but hardly reaches, middle of costa; at base of harpe two strong processes, one very long, curved and heavily chitinised, connecting it to base of the sacculus, the other much shorter, broader, and connected with costa beyond base; ædæagus moderately broad, strongly chitinised, terminating in two lobes, the narrow one of which is beset with fine teeth; vesica sub-globular, with five stout cornuti, four of which are very sharply pointed, the fifth and largest bluntly pointed, two of these four are about half the size of the others; most of the vesica finely punctulated.

From this it will be seen that there is hardly any difference in structure of foretibia, venation and male genitalia between *Ectocheila nigrilineata* and most species placed in *Centrarthra* and I have no doubt that the genotype of *Ectocheila* comes very close to *nigrilineata*, but until I have studied the genotype I leave *Ectocheila* provisionally here.

The species placed in this genus by Gaede may be distinguished as follows:

- 1a. Forewing with a pronounced dark shade or fascia below lower median 2
- b. Forewing of a uniform colour without a dark shade or fascia below lower median ¹⁾ 5
- 2a. Forewing with pale markings at base of C1 and C2 3
- b. Forewing without pale markings at base of C1 and C2 but with a short white striga at end of cell *roseitincta*
- 3a. Forewing with a yellowish lunule at base of C1 and C3 *flavilunata*
- b. Forewing with markings at base of C1 and C2 white 4
- 4a. White marking at base of C1 and C2 large, V-shaped; antemedial and postmedial lines fairly distinct *albilunata*
- b. Two small white maculae at base of C1 and C2; antemedial and postmedial lines absent *nigrilineata*
- 5a. Transverse lines very indistinct ¹⁾ *canina*
- b. Transverse lines distinct 6
- 6a. Forewing with a white streak at end of cell (not shown in the figure) *aberrans*
- b. Forewing without a white streak at end of cell *turneri*

***Ectocheila nigrilineata* Gaede (Fig. 4, pl. VI. 3.)**

Ectocheila nigrilineata Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915) ²⁾ and in Seitz, Gross-Schmett. XV. p. 59; pl. 7 (1934).

Exp. 38—40 mm. *Hab.* Type from South West Africa. In my collection and in that of the Transvaal Museum from Willowmore, (Cape Province), Socbatsfontein, Lekkersing, Brakt-Richtersveld, Hondeklip baai, Pofadder (South West Africa); November 1933.

This species comes close to *canina* Felder, if it is not the same; my female from Willowmore is just like a specimen in the British Museum placed under *canina*, but under that name were other specimens which I consider as being different. I have not seen Felder's type but, according to the figures by Felder and Gaede, my specimens agree best with *nigrilineata*. Seitz's figure of *canina* does not agree at all with Felder's figure, neither does the one given by Hampson. Both Felder's and Gaede's figures leave out the black streak below the cell and the ground-colour in Gaede's figure is grey and not white as given by Felder.

¹⁾ According to Gaede's figure it is absent in *canina*, in the text he states that it is sometimes absent; according to Felder's and Hampson's figure there is a narrow black line on lower median.

²⁾ See footnote for *Ulochlæna*.

Species auctorum.**Ectocheila canina** Feld.

Acronycta canina Feld., Reise Nov. pl. 100, f. 10 (1868).

Ectocheila canina Hmps., Cat. Lep. Phal. VI. p. 179, f. 48 (1906); Gaede, Seitz Gross-Schmett. XV. p. 59, pl. 7 (1934).

Exp. 38—44 mm. *Hab.* Cape Colony, Calvinia district, Uitenhage, Grahamstown.

Ectocheila albilunata Gaede.

Ectocheila albilunata Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915); Gaede, Seitz Gross-Schmett. XV. p. 60, pl. 7 (1934).

Ectocheila dasophrys Tams A. M. N. H. (10) 5, p. 487, pl. XVIII, fig. 3 (1930).

Exp. 35 mm. *Hab.* Type from South West Africa, Cape Colony.

Ectocheila flavilunata Gaede.

Ectocheila flavilunata Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915); Gaede, Seitz Gross-Schmett. p. 60, pl. 7 (1934).

Exp. 39 mm. *Hab.* ♀ Type from South West Africa.

Ectocheila roseitincta Gaede.

Ectocheila roseitincta Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915); Gaede, Seitz Gross-Schmett. XV. p. 60, pl. 7 (1934).

Exp. 38—42 mm. *Hab.* Type from South West Africa.

Ectocheila aberrans Gaede.

Ectocheila aberrans Gaede, D. ent. Zs. Iris, 29, pp. 101—123 (1915); Gaede, Seitz Gross-Schmett. XV. p. 60, pl. 7 (1934).

Exp. 34 mm. *Hab.* ♀ Type from South West Africa.

Ectocheila turneri Tams

Ectocheila turneri Tams, A. M. N. H. (10) 5, p. 488, pl. XVIII, fig. 8 (1930); Gaede, Seitz Gross-Schmett. XV. p. 60 (1934).

Hab. Cape Colony.

Genus CAFFRISTIS Hmps. (Fig. 4.)

Caffristis Hmps., Cat. Lep. Phal. VI. p. 227 (1906); Gaede, Seitz Gross-Schmett. V. p. 60 (1934).

Type, *ferrogrisea*.

Proboscis well developed; palpi obliquely upturned, third joint a little more porrect, reaching just beyond fringes of frons; second joint longer than first joint; third joint very short, covered with appressed scales; first joint mainly covered and fringed with very

long spreading hairs and hair-like scales mixed; second joint tufted with scales on sides, fringed with hair-like scales in front; frons smooth, upper portion with loosely tufted hair-like scales, continued over vertex; eyes with a few overhanging cilia; antennæ of male shortly bipectinated for about half of its length, then gradually becoming dentate; longest pectination a little over diameter of shaft; antennæ in female simple; thorax covered with long scales and hair-like scales mixed (not with hair only, as Hampson states); raised scales on tegulæ and a somewhat raised ridge of scales across patagia and thorax running to base of each forewing, reminding one of a small hood (the meta-thorax, according to Hampson, is supposed to have a spreading crest, but this is hardly visible; from base of mesothorax, however, is a pencil of long hair projecting beyond each patagia); abdomen without crests, covered with scales and each segment thinly fringed with hair, in addition some lateral tufts of hair; femora and tibiæ loosely covered with scales and fringed with hair and hair-like scales posteriorly; foretibia without claw; hindtibia with four spurs; outer spur about half of inner; tarsi covered on inner side with three rows of rather long spines. *Forewing*: shape and venation similar to *Rhodochlæna*, but costa a little incurved at middle, termen a little more oblique and tornus more rounded (quite a different shape to the figure given by Hampson), the areole is a little more elongate and M1 a little more remote from areole. *Hindwing*: similar in shape and venation to that of *Rhodochlæna* but RS and M1 slightly remote or from a point, M3 and C1 shortly stalked.

Male genitalia: abdomen without coremata at base; uncus moderately stout, tapering to a somewhat curved point, a little curved at base and somewhat arched at middle; tergite rather narrow and short, weakly chitinised; sternite a little longer but narrower and better chitinised, ending in a short, broad, rounded saccus; anus slightly chitinised below; valve very broad at base, rather short and suddenly tapering towards apex, which is rounded; costa very strongly incurved, termen correspondingly arched, edges of both beset with many long bristly hairs; costal area strongly chitinised and terminating in a raised acuminate process before and loose from tip of valve; sacculus rather narrow, broadest towards middle of valve, where there is a projecting raised lip at tornus; harpe from beyond middle of valve, arising from chitinised costal area and sending a long process to base of sacculus; harpe broad, heavily chitinised, flat, roundly pointed and slightly twisted; inner side of valve sparsely covered with short hairs, outer side with hairs and scales mixed; ædæagus rather weakly chitinised, short and stout, best chitinised at tip, where it is densely covered with very short spines on the under-side; manica densely covered with minute protuberances on upper side; juxta with some short bristles on posterior edge; vesica rather

short, bilobate, a larger lobe tipped with an area densely beset with short spines and partly punctulated; basal half of vesica with about 60 irregularly shaped, broadly based, finely pointed cornuti of different size, the smallest being at base and close together.

Only one species in this genus.

Caffristis ferrogrisea Hmps. (Fig. 4; pl. V. 2.)

Heliophobus ferrogrisea Hmps., Ann. S. A. Mus. II. p. 442 (1902).

Caffristis ferrogrisea Hmps., Cat. Lep. Phal. VI. p. 227, fig. 71 (1906); Gaede, Seitz Gross-Schmett. XV. p. 60, pl. 7 (1934).

Exp. 29—31 mm. *Hab.* Type from Masite (Basutoland), also recorded from Maseru. In my collection from Stellenbosch and Pretoria; in February and March.

Genus **EUMICHTIS** Hübn. (Fig. 4.)

Eumichtis Hübn., Verz. p. 211 (1822); Hmps., Cat. Lep. Phal. VI. p. 321 (1906); Gaede, Seitz Gross-Schmett. XV. p. 60 (1934).

Type, *lichena* from Europe.

Description from *rubrimixta*.

Proboscis well developed; palpi obliquely upturned, reaching a little beyond tuft of frons; second joint a little longer than first joint; third joint less than half of first joint, in female a little longer; all joints loosely scaled, fringed with long hair-like scales in front and on inner side; frons smooth, tufted with hair-like scales, which are longer on vertex; eyes large, rounded, without the overhanging cilia, which are supposed to be present; antennæ in male bifasciculated, in female very shortly biciliated; thorax covered with hair-like scales; a slight crest on pro- and mesothorax, and a large central crest on metathorax, also a short hair-pencil at base of hindwing; abdomen with a crest on first two segments; all segments covered with flat scales and with overhanging hairs from the anterior edge of each segment; a series of lateral hair pencils; femora and tibiæ densely covered and fringed with hair-like scales and hairs mixed; foretibia without a claw; hindtibia with four spurs, of which the middle pair is a little shorter; outer spur about half of inner; tarsi with three rows of short spines.

Forewing; of the same shape in the female as in *Rhodochlæna* a little narrower in male: venation as in *Rhodochlæna*, but areole a little longer. *Hindwing*: shape and venation as in *Rhodochlæna* but RS and M1 on a stalk of one-sixth of RS; M2 obsolescent and almost from middle of DC; M3 and C1 from a point.

Male genitalia: base of abdomen without coremata; uncus rather narrow, except at base, tapering to a curved point and well arched, fringed with hair on upper side and laterally; tergite rather

narrow, moderately chitinised, more strongly so along the edges, very narrow near uncus, but below uncus provided with a moderately chitinised lobe; sternite longer than tergite, narrow, well chitinised, broadening to a rounded saccus; anus slightly chitinised below; valve sole-shaped and roundly pointed, somewhat incurved at termen and arched at corresponding costa, apical one-fourth weakly chitinised, beset on inner side with stout papillated hairs, which become more dense and bristly towards apex; remainder of valve well chitinised; a rather short sacculus at base without a clavus; harpe broadly based from about middle of valve, strongly chitinised, tapering towards a rounded tip, somewhat incurved and with one broad process attaching it to inner margin and base of sacculus, a short process connecting it with the costal area; ædæagus bulbous at basal half, suddenly narrowing at terminal half, well chitinised; vesica rather long and tubular and with a group of three sharply pointed, broadly based cornuti well beyond base, one of which is smaller than the two others; remote from it, a similar isolated cornutus; at two-thirds length of vesica a very stout, roundly pointed, heavily chitinised, large cornutus which has a very broad oblique base and two rounded ridges before its tip; tip of vesica with a rounded patch densely covered with stout tooth-shaped cornuti, arranged in rows and directed inwardly, gradually diminishing in size towards outer side of patch; terminal half of vesica scobinated, gradually becoming punctulated; opposite the cornuti over the whole length of the vesica inside is a tube, strengthened by somewhat wavy chitinised ridges.

I really think that this species is better placed in the *Acronic-tids* and doubt that it is congeneric with the genotype of *Eumichtis* for, according to Pierce, *lichea* has a totally differently shaped valve and harpe, the uncus is supposed to have a hollow cap and the vesica is without cornuti but scobinated where it joins the ædæagus. I have no doubt that the identification of my specimens is correct, as the Pretoria female is just like the type and the Pretoria male is just like that female.

***Eumichtis rubrimixta* Hmps. (Fig. 4; pl. V. 4.)**

Eumichtis rubrimixta Hmps., Cat. Lep. Phal. VI. p. 347; pl. CIV. fig. 18. (1906); Gaede, Seitz Gross-Schmett. XV. p. 60. pl. 7 (1934).

Exp. 36—39 mm. *Hab.* Type from Johannesburg. In my collection from Pretoria and Rietfontein; II., XI., XII.

Genus HYPOTYPE Hmps. (Fig. 3.)

Hypotype Hmps., Cat. Lep. Phal. VI. p. 384 (106); Gaede, Seitz Gross-Schmett. XV. p. 61 (1934).

Type, *scotamista* Hmps.

Proboscis well developed; palpi obliquely upturned, third joint a

little more porrect, just reaching frons; first and second joint of even length, third joint half that length; first and second joint loosely scaled, fringed in front with hairs and hair-like scales; third joint with more appressed scales; frons smooth, loosely covered with long scales and hair-like scales mixed; vertex even more roughly covered with scale-like hairs; overhanging cilia fairly distinct, spreading and covering one-third of eyes; antennæ simple with minute cilia, first joint with a tuft of scales in front; tegulæ covered with scales, somewhat erected at middle, so as to form a small hood; patagia and remainder of thorax covered with scales and scale-like hairs mixed and without crests; first abdominal segment with a distinct crest; abdomen covered with scales, each segment thinly fringed with moderate hairs inserted on anterior edge, also some lateral fringes of hairs and scales mixed; femora and tibiæ covered with scales and densely fringed posteriorly and laterally with long hairs; underside of thorax and base of abdomen densely covered with woolly hair; foretibia without a claw; hindtibia with two pairs of long spurs; outer spur two-thirds of inner; tarsi with three rows of stout spines. *Forewing*: in shape somewhat like the typical *Cucullia* but costa at apex less arched, termen more erect, tornus more rounded; venation similar to that of *Cucullia*, but areole somewhat longer, R5 from end of areole and M1 somewhat remote from areole. *Hindwing*: as in *Cucullia*, but M2 much stronger developed, termen even slightly crenulate at that vein, and C1 from a little before angle.

Male genitalia: base of abdomen without lateral coremata; uncus stout, strongly curved at base, then straight and suddenly tapering into a curved point, well chitinised, upper terminal half well covered with long hairs; from about middle of uncus a lateral lobe on each side, which also seems to be well chitinised and which is densely covered with very short bluntly pointed bristles; tergite rather narrow, of even width, suddenly tapering to a rounded point, well chitinised, strongly so along anterior edge, posterior edge fringed with long hair; sternite rather narrow, ending in a very short saccus, well chitinised; anus somewhat chitinised below valve, moderately broad, suddenly contracting beyond middle, somewhat expanding towards tip, which is truncate and provided with a corona consisting of very long somewhat curved, rather separated bristles; terminal two-thirds of valve, except along inner margin, rather weakly chitinised, remainder well chitinised; inner side of weakly chitinised portion densely covered with long hairs, outer side of terminal half of valve densely covered with very long hairs; sacculus rather long and a little over half of width of valve and provided beyond its base with a broad, rounded-off, well chitinised clavus; sacculus itself terminating on upper side in a somewhat short rounded lobe, which has several crinkles over it, remainder of sacculus merging into the

heavily chitinated inner margin, from which originates a short slightly chitinated finger-shaped process (this may represent the harpe); from before middle of costa another heavily chitinated process, which is strongly curved at base, then incurved and rounded off terminally (this process may be the harpe and is somewhat longer in the right valve, as is also the case with the smaller process previously mentioned); the right valve further differs from the left valve in having an additional broad process, originating from middle of valve and projecting beyond the costa; at tornus the inner marginal area is somewhat produced and heavily chitinated and appears to be separated from the less chitinated terminal area by being twisted inwardly; in the right valve the terminal part is broader than in the left valve; juxta very long, well chitinated, gradually merging into the manica, which is finely punctulated on the upper side, crinkled below; ædæagus long, narrow at basal half, gradually becoming much wider at terminal end, where it gradually merges into the rather short vesica; a little beyond base of vesica five irregularly shaped cornuti, of which two are minute; at tip of vesica two very stout, heavily chitinated long cornuti, one of which is longer and very broadly based, both cornuti seem to be connected to each other by means of a chitinated area of the vesica (similar to the large cornutus found in *Neocucullia albisignata*); a chitinated ridge, connected with base of largest cornutus, apparently attached to the whole of the vesica, which is there somewhat chitinated.

Three species have been placed in this genus, one of which is from Palestine. The two African species may be distinguished as follows;

- a. Forewing with a black streak below base of cell; orbicular large, rounded; subterminal line represented by a series of black dentate marks, with a whitish suffusion beyond them, slightly angled outwardly at R5 and inwardly in submedian fold; a short black streak on extremity of C2 *nigridentata*
- b. Forewing without a black streak below base of cell; orbicular a small pale ocellus; subterminal line very indistinct, whitish, defined by fuscous on inner side, somewhat dentate on veins R5 and M1 and excurved at middle; no black streak on extremity of C2 *scotomista*

Hypotype *scotomista* Hmps. (Fig. 3; pl. V. 3.)

Polia scotomista Hmps., Ann. S. A. Mus. II. p. 278 (1902).

Hypotype scotomista Hmps., Cat. Lep. Phal. VI. p. 386, fig. 128 (1906); Gaede, Seitz Gross-Schmett. XV. p. 61 (1934).

Exp. 40—45 mm. *Hab.* Type from Cape Town; also recorded from Coast belt of Natal and Kokstad (Cape Colony); in my collection from Durban in February.

Species auctorum**Hypotype nigridentata** Hmps.

Polia nigridentata Hmps., Ann. S. Afr. Mus. II p. 278 (1902).

Hypotype nigridentata Hmps., Cat. Lep. Phal. VI. p. 385, pl. CV. fig. 6 (1906); Gaede, Seitz Gross-Schmett. XV. p. 61, pl. 7 (1934).

Exp. 44 mm. *Hab.* Type from Transkei (Cape Colony).

Genus GRAMNOSCELIS Hmps.

Gramnoscelis Hmps., Cat. Lep. Phal. VI. p. 468 (1906); Gaede, Seitz Gross-Schmett. XV. p. 61 (1934).

Type *leuconeura*.

Gramnoscelis leuconeura Hmps.

Gramnoscelis leuconeura Hmps., Cat. Lep. Phal. VI. p. 468, fig. 160 (1906); Gaede, Seitz Gross-Schmett. XV. p. 61, pl. 7 (1934).

Exp. 30 mm. *Hab.* Male type from Deelfontein (Cape Colony).

Only one female in my collection from Graaf Reinet.

I hope to be able to give the male genitalia at some future date when material becomes available.

Genera et species auctorum.**Genus RHIZOTYPE** Hmps.

Rhizotype Hmps., Cat. Lep. Phal. VI p. 373 (1906); Gaede, Seitz Gross-Schmett. XV. p. 60 (1934).

Type, *flammea* from Europe.

One species in South Africa.

Rhizotype palliata Warr.

Rhizotype palliata Warr., Ann. S. A. Mus. X. p. 469, pl. XL. f. 2 (1914).

Exp. 40 mm. *Hab.* Hout bay (Cape Colony).

Genus DASYPOLIA Guen.

Dasypolia Guen., Noct. II. p. 44 (1852); Hmps., Cat. Lep. Phal. VI. p. 422 (1906); Gaede, Seitz Gross-Schmett. XV. p. 61 (1934).

Type *templi* from Europe.

Only one species recorded from South Africa.

Dasypolia informis Wlk.

Dasypolia informis Wlk., Cat. X. p. 402 (1856); Hmps., Cat. Lep. Phal. VI. p. 423, fig. 146 (1906); Gaede, Seitz Gross-Schmett. XV. p. 1, pl. 7 (1934).

Exp. 40 mm. *Hab.* Type from "Interior of S. Africa". I have not come across this species yet, although it is readily recognised.



Photo Janse

Male genitalia of: 1. *Cucullia brunnea* x 8; 2. *Cucullia perstriata* x 4; 3. *Cucullia extricata* x 4; 4. *Cucullia terreusis* x 4; 5. *Cucullia atrimacula* x 4; 6. *Cucullia minuta* x 4; 7. *Empusada hutchinsoni* x 4; 8. *Empusada argentivitta* x 4; 9. *Empusada chrysota* x 8; 10. *Empusada pallidistria* x 4; 11. *Rhodochlæna botonga* x 8; 12. *Leucochlæna leucogonia* x 8; 13. *Ulochlæna fumea* x 8.



Photo Janse

Male genitalia of: 1. *Caridea elegantissima* $\times 8$; 2. *Caffristis ferrogrisea* $\times 8$; 3. *Hypotype scotomista* $\times 4$; 4. *Eumichtis rubrimixta* $\times 8$; 5. *Cucullia albifuscata* $\times 8$; 6. *Cucullia nigrilinea* $\times 8$; 7. *Cucullia platti* $\times 8$; 8. *Cucullia pallidicolor* $\times 8$; 9. *Cucullia consimilis* $\times 8$; 10. *Cucullia maqualis* $\times 8$; 11. *Cucullia daedalus* $\times 8$; 12. *Copicullia ruptifascia* $\times 8$.

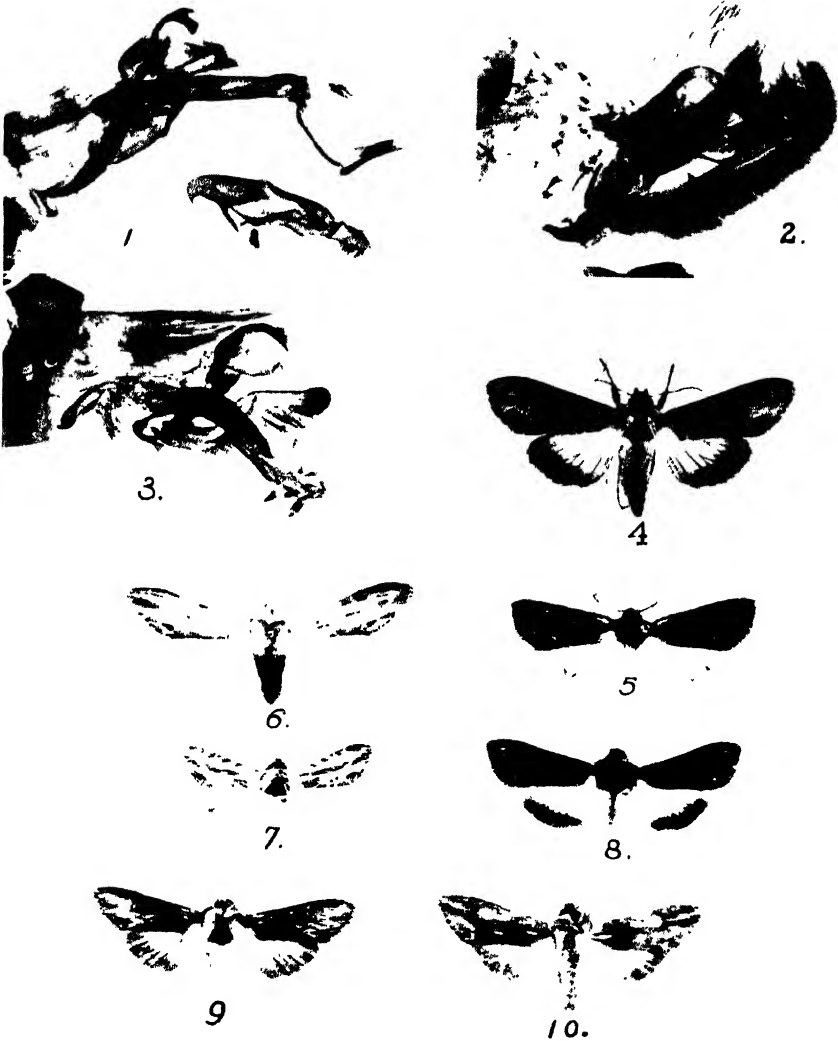


Photo Jansz

Male genitalia of: 1. *Neocucullia albisignata* x 8; 2. *Cucullia artemisiae* x 8;
3. *Ectocheila nigrilimeata* x 8.

Moths at natural size of: 4. *Cucullia platti* Prout; 5. *Neocucullia albisignata*
spec. nov. ♂ type; 6. *Cucullia pallidicolor* spec. nov. ♂ type; 7. *Cucullia albifus-*
cata spec. nov. ♂ type; 8. *Cucullia maequalis* spec. nov. ♀ type; 9. *Cucullia nigri-*
linea spec. nov. ♂ type; 10. *Cucullia dedalis* spec. nov. ♀ type.

On the control of temperature and humidity of air in small cabinets

by

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For the study of certain aspects of insect development it is generally desirable to carry out experiments in an atmosphere of which the temperature and humidity remains constant over long intervals of time.

The particular system of control to be used will depend on a) whether the air is limited to a confined space, as for example in small cabinets for experiments on insects, in which the same air is used over and over again or b) whether there is a continuous supply of fresh air, as is for instance the case in general air-conditioning in houses. In this paper case a) only will be considered.

A given volume of air at a certain fixed temperature can contain varying amounts of moisture in the form of vapour, up to a certain maximum amount which is required to saturate it at that particular temperature. This maximum amount which the air can contain depends on its temperature, more moisture being required to saturate the air at a higher than at a lower temperature.

It follows from this that the degree of saturation of a certain volume of air containing a certain fixed amount of moisture will depend on its temperature. Lowering the temperature will increase its degree of saturation or relative humidity even if no extra moisture is added. Similarly the humidity is decreased if the temperature is raised.

The degree of saturation of moist air at a given temperature is determined by the dew-point temperature, i.e. the temperature to which the air must be cooled in order to bring it to a state of saturation; the dew-point temperature, in other words, is the temperature at which condensation will start.

The amount of water vapour in a given volume of air can be decreased by circulating it over a cold body the temperature of which is below that of the dew-point temperature corresponding to the original state of humidity of the air. Vapour will condense out on to the cold body and will continue to do so until the humidity of the air (which we assume is kept at a constant temperature e.g. by

heating it again to the required temperature after it has left the cold body) falls to a value for which the cold body temperature is the dew-point.

Humidity or degree of saturation is the ratio —

$$\frac{\text{Amount of moisture actually contained in a given volume of air}}{\text{Amount of moisture required to saturate this volume of air at the same temp.}}$$

Simple reasoning then leads to the following —

Relative Humidity } = 100 $\frac{\text{Max. vapour pressure at dew-point}}{\text{Max. vapour pressure at temp. t.}}$
of air at temp t. }

This relation enables one to calculate the dew-point temperature for any particular state of humidity.

Assuming for the moment that the temperature of the air inside a well insulated cabinet is kept constant, and is higher than the temperature of the surrounding atmosphere, then the humidity is very simply controlled by merely introducing into the cabinet a cold brine coil of which the temperature is equal to that of the dew-point temperature required for the particular humidity desired. Here the brine coil only serves the one purpose viz. that of preventing the humidity of the air from increasing beyond a certain value which is fixed by the temperature of the brine coil.

This simple arrangement will only prevent the humidity from rising and makes no provision for preventing a possible decrease in humidity. If the temperature inside the cabinet is to be kept lower than that of the surroundings this simple arrangement will not answer the purpose, as in this case the brine coil also has to serve the further purpose of keeping the temperature of the air in the cabinet down to the required value.

The air in the cabinet will receive heat from the surrounding atmosphere by conduction through the (imperfect) insulation and to keep the temperature inside the cabinet constant, heat must be removed from it by the brine coil, at a rate equal to or greater than the rate at which it comes in. In practice, the amount of heat entering the cabinet is kept as low as possible by arranging for effective insulation, but with low cabinet temperatures in summer even a four inch thick cork insulation allows a fair amount of heat to pass into the cabinet. The rate at which the brine coil removes heat from the cabinet, assuming the air in the cabinet to be well circulated, depends, a) on its effective surface area in contact with the air in the cabinet and b) on the difference between its temperature and that of the air in the cabinet.

It is advisable to make the effective surface area of the cooling coil as large as possible since the control provided under b) is limited. For instance, if it becomes necessary to have the temperature of the

cooling coil below the freezing point of water, then ice forms on the surface of the coil, and with constant humidity in the cabinet, this layer of ice will get thicker as time goes on. The thermal conductivity of ice being low, this layer of ice will reduce the effectiveness of the cooling coil, and it sets a limit to the extent to which the cabinet can be cooled below the temperature of its surroundings.

But apart from this, we have seen that lowering the temperature of the cooling coils means lowering the humidity in the cabinet, and if a constant humidity is required higher than that for which the cooling coil temperature is the dew-point, then it becomes necessary to introduce water vapour into the air in the cabinet at a rate equal to or greater than the rate of condensation on the cooling coil. This moisture can be introduced in various ways but perhaps the most satisfactory method is to use some form of atomizer as used for scent sprays.

A set of four cabinets has recently been erected for the Locust Research Laboratory of the Department of Agriculture and Forestry at the University of Pretoria. The method used for the control of temperature and humidity in these cabinets is based on the scheme adopted by the Bureau of Entomology and Plant Quarantine in its Laboratory at Twin Falls, Idaho, U.S.A. and described by Dr. P. N. Annand in the Manual of Entomological Equipment and Methods Part I. by Alvah Peterson. We are much indebted to Dr. Annand for sending us a detailed description and a set of illustrations of the cabinets installed at Twin Falls.

Details of the construction of the Pretoria cabinets are given in the accompanying diagrams I, II, and III.

Each cabinet is fitted with a metal pipe (preferably a hot water wall-radiator) through which cold brine solution at about 31° F flows continuously. The rate of flow of the brine and hence the temperature of the coil, is controlled by a hand-operated gate valve outside the cabinet. The brine flow is regulated so that the air temperature inside the cabinet, is slightly below the required temperature while the heating coil is not operating.

A 500 watt heating element under thermostatic control maintains the required constant temperature. The air is circulated by a small, continuously running electric fan fitted into a hole in the top of the baffle shown in fig. III.

If the humidity of the air is high enough, moisture will condense on the cold brine coil and this dehumidification of the air will proceed until the relative humidity has dropped to a value for which the temperature of the brine coil is the dew-point. Should a lower humidity be required at the same temperature, then it would be necessary to increase the brine flow i.e. to lower the temperature of the brine cooling-coil. For the temperature in the cabinet to remain constant

the heating element will now have to supply more heat by remaining on for longer intervals. When once the temperature of the brine coil has been adjusted to keep the humidity of the air below the required value, then extra water vapour is supplied from time to time by a water spray operated by a humidostat.

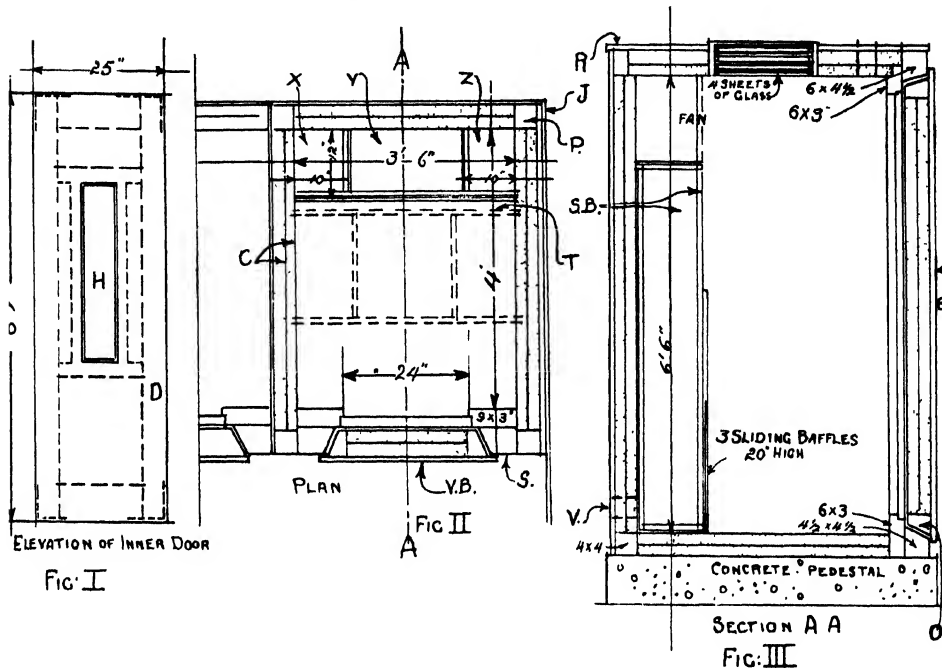


Fig. I.

H. = Hinged, Glazed, Inspection Panel
 D. = Door 1 1/4" Skeleton Framing, Covered Both Sides with PLY-MAX.

Fig. II.

C. = 2" Slab Cork Insulation.
 J. = Vertical T & G "V" Joined Boarding.
 P. = 4" x 4" Angle Posts.
 S. = 7 x 4" Style.
 T. = 6 x 1" Trimming for Roof Lights.
 V.B. 1" Vertical Boarding.

Fig. III.

B. = 1" Boarding.
 O. = 1 Outer Door fitted with Double Seal.
 R. = 1" Boarding Roof.
 S.B. = Sheet Iron Baffles with 1 1/4" x 1 1/4" x 3/16" Angle Framing.
 V. = 3" Diameter Hit & Miss Ventilator.

The brine cooling-coil thus serves a double purpose; it has to keep both temperature and humidity below their required values. The thermostat controls the heating element so as to supply just sufficient extra heat to keep the temperature constant at the required value, and the humidostat controls the water spray so as to supply just sufficient water vapour to maintain the required constant humidity.

Each of the four cabinets at the University of Pretoria has four

inches of cork insulation all round; this is found quite adequate for temperatures between 40° F and 120° F. The cabinets are lined throughout with galvanized iron painted over with aluminium paint. This gives a neat finish to the interior and at the same time renders it waterproof. Within limits, the size of cabinet used will not effect the efficiency of this system, provided the effective surface area of the brine coil is large enough.

The amount of air drawn up through each of the channels X Y and Z shown in figure II is controlled by sliding baffles fitted below, as shown in figure III. The heating element is fitted inside channel X; channel Y contains a four-segment wall radiator, through which brine at a temperature of 34° F is circulated; channel Z contains a small atomizer.

The air pushed into the cabinet by the fan therefore consists of a mixture of three air streams a) moist air coming through channel Z; b) cold dry air coming through Y, and c) hot air coming through X. Should this air mixture be deficient in moisture, the humidostat will open the solenoid valve which connects the atomizer to the compressed air supply. The temperature of the hot air supply on the other hand is controlled by a thermostat so as to keep the temperature of the air in the cabinet constant at the required value.

Each cabinet is fitted with two 3" hit-and-miss ventilators. Tests have shown that there is no appreciable fluctuation of temperature or relative humidity, even if both ventilators are wide open.

The reservoir from which the atomizer draws its water consists of a galvanized iron vessel, fitted with a slightly hollowed lid provided with holes. This vessel is placed immediately below the brine coil and its lid is large enough to receive all the condensed water dripping from the coil. The same water is thus used over and over again, and this is a great advantage in regions where the water contains many dissolved impurities, as it enables one to start with distilled water and so avoid trouble due to the deposit of lime in the small hole of the atomizer jet.

A metal tank 5' × 2' × 2' 6" made of 10 S.W.G. steel welded together, serves as a brine reservoir. The tank is lagged all round with 4" cork insulation set in bitumastic cement. The exterior is covered with 3¼" × 7/8" T. & G. & V. jointed pitch-pine boarding. Fitted into an opening in the top is a removable stainless sheet-steel vessel, reaching well into the brine solution in the tank; the opening is closed in by a four-inch cork insulated lid.

The brine solution, made in the proportion of 4 lbs. calcium chloride to one gallon water, is kept at about 34° F by a MAR — 200 — R twin cylinder Vertical Reciprocating Curtis compressor driven by a two horse-power electric motor. The condensing unit is con-

trolled thermostatically by means of a submerged bulb thermostat working in conjunction with the magnetic starting switch.

The cold brine solution is circulated continuously through the cooling coils in the cabinets by a centrifugal pump capable of delivering 20 gallons per minute. The pump is coupled directly to a $\frac{1}{2}$ horse power electric motor. All the brine pipes are lagged with 2" moulded cork insulation, canvas wrapped and painted with aluminium paint.

Compressed air to operate the atomizers is supplied by an ordinary garage-type compressor and reservoir. The reservoir is fitted with an automatic pressure cut-out which is adjusted to keep the air pressure within the limits of 120 lbs per sq. in. and 90 lbs per sq. in. In each cabinet the solenoid air valve between the atomizer and air supply is operated by an electric-contact humidostat through a mercury switch relay of the latching type. Both the humidostat and relay were supplied by Negretti and Zambra. Their catalogue numbers are R/116 and R/117 respectively.

The heating element is operated by a dial thermostat of the Mercury in steel type — Negretti & Zambra R/143. The thermostat has a scale reading from 30° F to 220° F and is fitted with a TT/210 type bulb. It operates the heating element through a R/148 relay.

These cabinets have now been used continuously for some months and have given every satisfaction. Wet and dry bulb humidograph records taken over a period of some weeks show a remarkable constancy of both humidity and temperature.

The classification of the recent hexapod insects

by

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Introduction.

The older naturalists used the word "insect" to denote any terrestrial Arthropod. To-day the word has this significance in the vulgar tongue. The boundaries of the "Class Insecta" are by no means clearly defined: Handlirsch in 1908 broke up the hexapod insects into four "Classes", while to-day the six legged Myrientomata are bandied about between the "Insecta" and the "Myriapoda", so that no certainty exists as to the significance of the Entomological term "Insect".

The adoption of a well known and old established vulgar word as a technical scientific term is unfortunate. This has been realised by a number of Entomologists who have used the term Hexapoda to distinguish those six-legged insectous animals which possess one pair of antennae and three pairs of appendages modified as jaws. To make the scope of the present paper clear the term hexapod insects has been used to embrace all those six legged mandibulate arthropods which are usually included in the "Class Insecta."

Owing to the great abundance and importance of the hexapod insects and the ease with which they can be collected and preserved the study of these animals has followed a different course from that of the other "Classes" of the Animal Kingdom. It has been in the hands of specialist Entomologists and in consequence, although it has made great progress in some directions, its development has been divorced from that of the Animal Kingdom as a whole. This has naturally had an unfortunate effect upon investigations of comparative anatomy and so upon the classification of the group: which is very generally acknowledged to be in a most unsatisfactory state.

During the last forty years much new morphological knowledge has been accumulated and a number of new orders, both recent and fossil, have been described. Great progress has also been made in our knowledge and understanding of the morphology of the other groups of Arthropoda and the work of W. T. Calman on the Crustacea has provided a firm basis for a classification of the Mandibulate Arthropods. To-day the time seems ripe for an attempt to place the classification of the hexapod insects on a more satisfactory basis.

The classification of the Animal Kingdom is a matter of practical, rather than academic, importance. It cannot be perfectly systematised because it deals with an almost continuous series which has been broken into a collection of irregular groups, no two of which have precisely the same value. The larger of these groups, cannot be defined in any formal manner ¹⁾, for living matter is variable and any definition which will cover all the possible variations of one monophyletic group must be so loose as to be useless as a means of identification. It may therefore be useful to state the aim and method which have resulted in the classification here put forward.

The aim of this classification is to divide the Hexapod insects into a series of groups which will make possible their orderly arrangement and at the same time display their natural affinities and indicate the degrees of their diversity.

The method which has been used is the "type" method as described below, which is, I believe, the only system by which a workable classification can be produced. This old method appears to be based upon a misconception. The early naturalists, who believed that all the species of animals were the product of special creation, noticed that they fell into natural groups having a common anatomical plan and the appearance of genetic relationship. This they explained on the hypothesis that the Creator had a number of plans or ideas which He varied in detail to produce a great variety of species. Thus for each group there was a central type which, stripped of its minor anatomical detail, could be formulated mentally as an archetype. This method supplemented by a consideration of phylogeny and tempered by practical considerations of custom and convenience has been used in this work.

This method cannot be described as natural, for it has a meta-

¹⁾ Darwin in his masterly essay on Classification (Origin of Species Ch. XIV) draws attention to this difficulty and gives as example the Crustacea. Almost any group of animals containing a wide diversity of species would do equally well. The Hexapoda for example might be defined as *tracheate hexapod Arthropoda with one pair of antennae, three pairs of appendages modified as mouthparts and having the body divided into head, thorax and abdomen*, but, the Arthropodea and some Protura have no tracheae, a number of species are apodus during some period of their life history and a few are apodus both as larvae and imagines, Protura lack antennae and so do some parasitic Pterygota, the imagines of the Ephemeroptera etc. do not possess three pairs of appendages modified as mouthparts and it is doubtful whether the Anopleura do so at any stage in their life history, while, finally, in many larvae and some adult insects the distinction between head, thorax and abdomen has been partially or entirely lost. The same difficulty applies to much smaller groups but usually not to the same degree, although a few moments consideration will show that in some cases, for example the Diptera, no definition, which will distinguish the group from the rest of the Animal Kingdom and at the same time apply to all the individuals, is possible.

physical concept as its basis, yet it results from a study of natural groups and is certainly not an artificial system. Neither a purely natural nor an entirely artificial system is practical. An artificial system requires a series of definitions which, as they would have to be redrafted at frequent intervals owing to the discovery of new species, is a counsel of perfection never likely to be achieved. A natural classification must be based upon the degree of genetic relationship, but, as the degree of variability of the germ-plasm varies greatly, such a system would be entirely dependent upon palaeontology with its very imperfect records and, even if it could be perfectly achieved, would be useless for practical purposes: Two lines of descent which arose early in the Carboniferous period may be structurally and physiologically very similar, whereas two lines having a common ancestor in the Eocene period may be widely separated in these respects. Thus it comes about that the method employed is a metaphysical method based on what appears to be a misconception and having no secure scientific foundation but which is yet a sound practical method which, skilfully employed, will produce the required results.

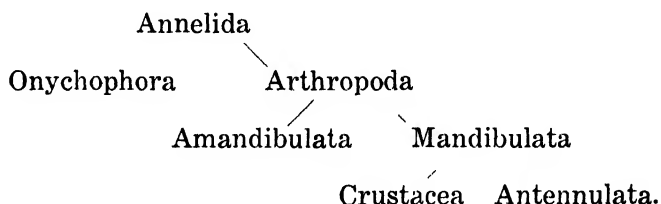
The position of the Class Hexapoda.

It is very generally admitted that the Hexapoda are derived directly or indirectly from an Annelid stock. Some authors have supposed them to have arisen directly from the Annelida, others that they descended through some Onychophoran ancestor while the majority of zoologists connect them with the stock which gave rise to the Crustacea and "Myriapoda". They are by general agreement brigaded with the Crustacea, Arachnida and "Myriapoda" in the Phylum Arthropoda, although, were it a fact that they arose directly from the Annelids, such an arrangement would be incorrect. The great difficulties which have stood in the way of a clear appreciation of the natural position of the "Insecta" have been the inclusion of the Onychophora in the Phylum Arthropoda and the stress which has been laid upon the classificatory importance of the tracheae. These difficulties have passed away: the Onychophora, since the discovery of *Aysheaia pedunculata* by Walcott, C. D. 1911, *Smiths. Misc. Coll.* Vol. 57, p. 109, and its restudy by Hutchinson, G. E., 1930, *Proc. U. S. Nat. Mus.* Vol. 78, Art. II, pp. 1—24, pl. 1, who shows clearly that the Onychophora should be placed in a separate division of the "Articulata", have ceased to be a bone of contention; the presence of tracheal invaginations in the Isopoda and the fact that tracheae appear to have also evolved independently in more than one group of Arachnida makes it certain that tracheae are of little value as an indication of genetic affinity; it is but the force of tradition which makes mention of them a necessity.

The Crustacea, Myriapoda and Hexapoda are bound together by the similarity in the segmentation of the head. In all these groups there are six cephalic segments: the first, the pre-antennular segment, is vestigial, the second bears a pair of feelers, the "Antennules" of Crustacea and the "Antennae" of the Myriapods and Hexapods, the third, which carries the antennae of the Crustacea, is vestigial in Myriapoda and Hexapoda, the fourth bears the mandibles in all, and in all the last two bear appendages which are modified as mouthparts. These groups are therefore linked together and separated from the Arachnida, which have a very different series of appendages.

The classes of the "Myriapoda" show a closer relationship to the Hexapoda than do the classes of the Crustacea, owing to the disappearance of the "Antennae" in the adult, the structure of the mouthparts, and presence of salivary glands, well-defined malpighian tubes, and fat bodies. They may, therefore, be united into a Sub-Phylum Antennulata.

These relationships can be expressed in the form of a dichotomous series as follows:



To express such a relationship in full, in a classificatory system, would be cumbersome. The Annelida comprise a group of approximately equal morphological value to the Arthropoda and may, most conveniently, be given the rank of Phylum. The subdivision of the Arthropoda into two formal divisions, as it has little practical importance, can be omitted and the Crustacea, Antennulata and Arachnida are then ranked as Sub-Phyla.

The classification of the groups of Hexapoda.

The division of the Hexapod insects into a number of classes, as is done by Handlirsch, breaks away from tradition and is most inconvenient from the practical standpoint. It could only be justified if it were shown that the Hexapod Insects are polyphyletic. There is no morphological justification for such an extreme course, as the Hexapoda form a compact natural group showing less morphological diversity than do the Malacostracous Crustacea. I know of no evidence whatsoever that they are other than monophyletic.

Within the Class Hexapoda there are natural *groups* morphologically of considerably higher value than an Order, while other

groups embracing several Orders have little morphological value, but have been firmly established by custom. Those which are of real morphological significance have here been given the rank of a sub-class, while those which are useful or indicate relationships but have not the value of sub-classes are where possible given the status of a Division or Sub-Division.

Sub-Class Myrrientomata: The Order Protura stands alone amongst the Hexapoda in possessing twelve well-defined abdominal segments and, more importantly, in developing by anamorphosis. Some Entomologists believe that the latter peculiarity suffices for their exclusion from the Class. This point of view cannot be maintained after a consideration of the Chilopoda in which both anamorphosis and epimorphosis exist amongst forms not greatly dissimilar in other respects. Nevertheless the character seems to be of considerable importance; his view is strengthened by the fact that other peculiar features ¹⁾ are present in Protura. They are not closely related to other Hexapod insects and their degree of dissimilarity warrants their separation from the other Orders in a separate Sub-Class.

¹⁾ Some of the features which, either separately or in combination, serve to separate the Protura from other groups are:

Head: without eyes but with a pair of pseudocelli possibly homologous with the post antennal organs of the Collembola.

Thorax: prothorax reduced, mesothorax and metathorax well developed and with a larger number of pleural sclerites than is usual in Hexapoda.

Abdomen: possesses twelve segments, the reproductive opening in both sexes being between the eleventh and twelfth segments, twelfth segment simple and rounded.

Appendages: Antennae greatly reduced or absent; Mouthparts endognathous, Mandibles styliform, laciniae of maxilla deeply cleft, superlinguae not developed, labium greatly reduced; first pair of thoracic appendages directed forwards and apparently used as tactile organs, all thoracic appendages with a single tarsal segment and ununguiculate; appendages of the first abdominal segment with two segments; appendages of the second and third abdominal segments with one or two segments; other abdominal appendages including gonapophyses and cerci absent.

Digestive System: Simple, without proventriculus or diverticulae; two pairs of maxillary glands and one pair of glands opening on the labium; Malpighian tubes present as six small bodies consisting each of one or two cells only.

Respiratory & Circulatory Systems: Tracheae, if present, with meso- and meta-thoracic spiracles but do not anastomose; heart vestigial or absent.

Reproductive System: Lying below the gut; the ovary is similar in structure to a single ovariole, without nutritive cells, of the higher Hexapoda.

These characters vary greatly in significance. The complex pleural scleritization, which cannot well be regarded as adaptive and appears to relate them to the Chilopoda, and the position of the reproductive openings, are of high morphological value, separating the group very widely from all others, while the presence of pseudocelli, the absence of antennae, the structure of the mouthparts, the small prothorax, the structure of the tarsus, the presence of abdominal appendages coupled with the absence of gonapophyses and cerci, the large number of glands opening

Sub-Class Collembola: If the evidence of the Rhyne Chert has not been misinterpreted, the Collembola are the oldest known group of Hexapoda. There can be little doubt that they separated from the early Hexapod stock when it was as yet very ill defined. They differ from all other Hexapoda in having six segments only in the abdomen, which bears a "ventral tube", a hamula and a furcula; in lacking Malpighian tubes; and in having a sac-like ovary without a terminal germarium. Such characters are of high morphological value and cannot be dismissed as being the result of degeneration: indeed to describe such abundant and widely distributed insects, living under such a varied range of conditions, as either degenerate or highly specialized would be a misuse of these terms. They are, without doubt, an ancient and isolated group, showing less affinity to the main hexapod stock than do the Myrientomata, and their peculiarities amply justify the erection of a sub-class to contain them.

The differences which exist within the sub-class are considerable. In the present state of our knowledge they suffice for the erection of two Orders but it is not unlikely that, with further study, a greater number of Orders will be instituted.

Sub-Class Thysanura: Handlirsch divided the Thysanura into two Classes, while Brues and Melander separate them into two Orders. A middle course seems to be indicated. They approach the pterygote Orders in possessing eleven abdominal segments, and in other respects, and are separated from them chiefly by the absence of wings. They are clearly far removed from both the Collembola and the Myrientomata. The absence of wings is not a character of the profound significance of the anamorphosis of the Myrientomata or the six segmented abdomen of the Collembola, but it is one of great evolutionary importance and may therefore serve to separate them as a Sub-Class.

The distinctions between the Ectotrophi and the Endotrophi are considerable and the four families recognised by the majority of Entomologists differ from each other not less than some of the more nearly related orders of Pterygota. It will therefore be convenient to raise the latter to the rank of Order and to divide these Orders into two "Divisions" under the names Ectotrophi and Endothrophi.

Sub-Class Pterygota: The winged insects comprise a greater number of species than the whole of the remainder of the animal

into the mouth, the association of non-anastomosing tracheae with meso- and meta-thoracic spiracles, and the structure of the ovaries, which are each in themselves of no great morphological value, combine to form a facies which is far removed from that of any other group of Arthropoda and appears to indicate a degree of separation far greater than that which characterises the other Orders of Hexapoda, the old Order Collembola alone excepted.

Kingdom, yet in the main features of their anatomy they show little diversity and are distinguishable from the Thysanura by the possession of wings only. The number of orders is necessarily large, some authors recognise as many as thirty; to brigade these into Divisions and Sub-Divisions is therefore advantageous.

Divisions: There is a vague possibility that the winged hexapods are not monophyletic. The mayflies and dragonflies are ancient forms which appear to be related to the Thysanura Ectotrophi and differ from all other Pterygota in the musculature and venation of the wing, the structure of the tentorium and in possessing both an elongation of the eleventh abdominal segment and cerci. In the musculature of the wing the Odonata are highly specialized and stand apart from all other insects while the Ephemeroptera approach the latter more closely, yet it seems probable that it was from an Ephemerid type of musculature that the Odonatoid musculature arose. The ephemerid type of mandible, which strongly resembles that of the Ectotrophi and is remarkably Crustacean in appearance, is approached by those of some primitive Odonata but is not found in other Pterygota, while the abdominal gills of the larvae of Ephemerida and some primitive Odonata appear to be homologous and to have evolved independently of those of other Pterygotes. Thus these two highly modified groups are drawn together and separated from the others by a number of features, some primitive and others specialized. It would indeed be possible to defend a theory that *Grylloblatta* represents a primitive wingless pre-Orthopteroid stock not closely related to the Thysanuroid ancestor of the Ephemeroptera and Odonata and that the Pterygota arose from two divergent apterygote stocks, the one related to the Machilidae and the other having affinities with the Endotrophi. Such an hypothesis appears fantastic yet serves to show that the separation of the Ephemeroid and Odonatoid stocks from the main Pterygote stem must have occurred at an early evolutionary stage and that the two lines are widely divergent. Thus we can logically divide the Pterygota into two Divisions, the Archipterygota and the Neopterygota.

Division Archipterygota: This is characterised by the absence of wing flexure, the structure of the tentorium, and the presence of cerci together with an extension of the eleventh abdominal segment. The structural differences between the Ephemeroptera and the Odonata would fully justify their being placed in separate Sub-Divisions were other Orders present which could be associated with them; as no such Orders have, as yet, been discovered, no practical purpose is served by such Sub-Divisions, and they are omitted.

Division Neopterygota: This includes the majority of the exopterygote hexapods and all the endopterygote Orders. The division of the pterygote insects into Exopterygota and Endopterygota

has little to recommend it scientifically; the exopterygote Orders have, in some cases, been widely separated from each other since early geological periods, while the Endopterygota are almost certainly polyphyletic and are only linked together by the specialization of the larvae and the consequent metamorphosis which has resulted in that internal wing bud formation which is used to characterise the group. Metamorphosis is an adaptation which has arisen sporadically in many widely separated groups of animals and is not confined, even amongst hexapods, to the Endopterygota. The endopterygote condition is itself obviously adaptive and is unlikely to possess real classificatory value. The terms have, however, a long history and are so well established by custom that, in practice, they cannot be abandoned. By placing them in the category of Sub-Divisions their utility is maintained and their doubtful validity is, to some extent, indicated.

Other possible grouping of Orders: Handlirsch divides his Class Pterygogenia into eleven Sub-Classes which might conveniently be treated as Super-Orders. Unfortunately most of those which would be of practical utility are open to criticism and appear to have no secure morphological basis. No attempt has therefore been made to group the orders into Super-Orders.

Sub-Division Exopterygota: the majority of the Orders into which the Exopterygota are divided are well known and require no comment. The principal points which need explanation are:

Orthoptera: the old Order Orthoptera has been abandoned and no attempt has been made to retain the name for a restricted group, lest confusion arise. This *decision was arrived at on morphological grounds*¹⁾. The characters which unite the groups of insects generally designated as Families of Orthoptera are such as are common to all primitive Neopterygote hexapods. Such characters, if they be allowed classificatory importance, would lead to the inclusion of most of the Exopterygote groups in the one Order, which would thus be unmanageably swollen. The fact that Handlirsch on the Palaeontological evidence has divided the Orthoptera into four Orders, which he distributes between his two sub-classes Orthopteroidea and Blattaeformia, with which I was not acquainted until some time after I had decided that the Order must be split up, emboldens me to believe that my decision is well justified.

The four groups into which the Orthoptera are usually divided do not appear to be of equal morphological value. The Phasmidae are aberrant and very primitive forms showing little resemblance to any other known group. Their association with the other Orthopteroid insects appears to have been justified on negative considerations

¹⁾ A consideration of these will, it is hoped, form the subject of a later paper.

alone. The Saltatoria are a well-defined group with a characteristic morphology. The Blattidae and Mantidae show no great structural dissimilarity from each other, all the differences in their anatomy being associated with their mode of life, and in no case have these differences involved *radical morphological change*. In dividing the Orthoptera these two groups have been united as Sub-Orders of the Order Dictyophora (= Oothecaria) recognised by Leach and other early Entomologists.

The little known Grylloblatta was given the rank of Family by Walker but is placed in a separate order by Brues and Melander, who are followed here. This requires justification, as the needless multiplication of Orders is to be deprecated. These insects have been so little studied that it is as yet uncertain whether they are to be regarded as primitive or degenerate. To link them with any known group of Orthopteroid insects would be to express an opinion as to their affinities on evidence which appears to be insufficient. Their isolation as a separate Order calls attention to those difficulties and, by so doing, is justified.

The Anopleura: This Order has recently been expanded to contain both the biting and sucking lice. Such a fusion may be justified from the phylogenetic standpoint but cannot be tolerated morphologically. In the structure of the mouthparts, the thorax, and the general body form, they are distinct and easily recognised groups. If they be united, any attempt to keep some degree of uniformity in the treatment of Arthropod classification must lead to the number of Orders being radically reduced. Proof that two groups of animals arose from a common ancestor is no argument for their being placed in one Order. Were such an attitude generally adopted classification would become impracticable.

The Zoraptera: this group is imperfectly known; if it be united with the Psocoptera serious difficulty accrues. The Psocoptera are a compact and easily recognised group with affinities to the Embioptera and, possibly, to the Anopleura. If the Zoraptera are added the group becomes loose and difficult to define; it would then be hard to find valid reasons for the exclusion of the Embioptera. From a practical and a morphological standpoint such indefinite groups are undesirable. Their only interest is to the phylogenist. To destroy a most satisfactory little Order for the purpose of finding a home for an obscure group of doubtful affinities appears a wanton act.

The Hemiptera: on morphological grounds there is some justification for the division of the Hemiptera into two Orders: yet such a division seems unnecessary. The Hemiptera appear to be monophyletic and more closely related than the Anopleura and Mallophaga or the Zoraptera and Psocoptera, indeed it is doubtful

whether they differ more than do the Sub-Orders of the Odonata and Hymenoptera. As the morphological considerations do not appear to make imperative such a disjunction it would show lack of respect for tradition to break up a group well known to Entomologists for generations.

Sub-Division Endopterygota: The only difficulties here met with are to be found in the "Panorpoid Complex" and are as follows: —

Neuroptera: This Order, once so great, has suffered many reductions and it seems clear that, even as it stands to-day in many classifications, it is still too heterogenous. Following a well established precedent the name has been retained for the Planipennia after the removal of the Sialidae and Raphidiidae. These latter groups appear to me rather more closely related than Handlirsch and Brues and Melander suppose ¹⁾ and, in consequence, they are united as Sub-Orders of the Order Megaloptera.

Trichoptera: There appears to be neither morphological nor genetical justification for this Order which should be united with the Lepidoptera. Tradition and custom are, however, so strong that to do so would be to make an impotent academic gesture. The artificial Order Trichoptera has therefore been retained on grounds of expediency.

Nomenclature.

This work was commenced more than ten years ago for the benefit of students. Later I hoped to make a thorough search of the literature and to attempt to employ the rule of priority. This is now impossible, and the opportunity seems to have passed me by for ever.

The Law of Priority has never been applied to the higher groups of animals and its application in the future is unlikely. My defection has, therefore, no serious consequences. I have used the names most familiar to me except in a few cases where a new name appeared to be desirable; as for example in the case of the Locustoidea and Acridioidea, which are stumbling-blocks to students.

The name of the Sub-Phylum Antennulata I owe to that most excellent morphologist L. A. Borradaile to whose clear exposition I owe almost as much as I do to my "Master", W. T. Calman.

¹⁾ The two groups have evolved under very different oecological conditions and in consequence must be expected to differ widely through adaptive radiation. I can perceive no differences which cannot be explained in this way. The basic morphology appears to be the same in both the larvae and the imagines. The great similarity in the wing venation is, therefore, a strong argument for the inclusion of both groups in a single Order. The matter cannot be further discussed here as my information has been largely derived from the work of a former pupil which is as yet unpublished.

Bibliography.

No complete bibliography can now be attempted and a selection of the literature would serve no useful purpose. My information has been derived from discussions with specialists met at the British Museum, the Verrall Supper, and elsewhere, the examination of material, the investigations of students, original papers, the text-books Berlese, Imms, Packard, Schroder, Sedgwick, Sharp, Snodgrass, and Tillyard, and the Key of Brues and Melander.

Classification.

Phylum Arthropoda.

Sub-Phylum Antennulata.

Class Hexapoda.

Sub-Class Myrientomata.

Order Protura.

Sub-Class Collembola.

Order Arthropleona.

„ Symphypleona.

Sub-Class Thysanura.

Division Endognatha.

Order Campodeida.

„ Japigida.

Division Ectognatha.

Order Lepismata.

„ Machilida.

Sub-Class Pterygota

Division Archipterygota.

Order Ephemeroptera.

„ Odonata.

„ Sub-Order Anisoptera.

„ Anisozygoptera.

„ Zygoptera.

Division Neopterygota.

Sub-Division Exopterygota.

Order Plecoptera.

„ Embioptera.

„ Isoptera.

„ Zoraptera.

„ Psocoptera.

„ Sub-order Parapsocoptera.

„ Eupsocoptera.

„ Phasmida.

„ Grylloblattida.

„ Saltatoria.

„ Sub-order Longicornuta (= Locustidae, etc.)

„ Brevicornuta (= Acridiidae)

„ Dictyophora.

„ Sub-order Blattida.

„ Mantida.

„ Dermaptera.

- Sub-order Arexenina.
- " Hemimerina.
- " Forficulina.
- " Thysanoptera.
- Sub-order Terebrantia.
- " Tubulifera.
- Order Mallophaga.
- " Anopleura.
- " Hemiptera.
- Sub-order Homoptera.
- " Heteroptera.
- Sub-division Endopterygota.
- Order Neuroptera.
- " Megaloptera.
- Sub-order Sialida.
- " Raphideida.
- " Mecoptera.
- Sub-order Protomecoptera.
- " Eumecoptera.
- " Trichoptera.
- " Lepidoptera.
- Sub-order Homoneura.
- " Heteroneura.
- " Diptera.
- Sub-order Nematocera.
- " Brachycera.
- " Aphaniptera.
- " Coleoptera.
- Sub-order Adephaga.
- " Polyphaga.
- " Strepsiptera.
- " Hymenoptera.
- Sub-order Symphyta.
- " Apocrita.

Obituary

G. A. H. Bedford.

In the death of Mr. G. A. H. Bedford, on 28th January 1938, Entomology in South Africa lost one of its foremost systematists, a



G. A. H. BEDFORD

loss the more lamentable considering the insignificant number of workers available in this huge field so vital to the interests of applied entomology.

Mr. Bedford was born in England in May 1891. After embarking on an entomological career, he worked at the British Museum for a time with the late F. V. Theobald. In February 1912 he was ap-

pointed as Entomologist at the Onderstepoort Veterinary Laboratories, and in 1920 as a Research Officer, a position that he held up to the time of his death. Partly perhaps from choice, partly also on account of the nature of the work carried out at the Veterinary Laboratories, he concerned himself mainly with those insects and related forms, such as mites and ticks, associated with vertebrates and concerned in the transmission of diseases. At the same time he had a very wide interest in Entomology and a broad general knowledge of the science as a whole.

He seems to have been particularly keenly interested in the Mallophaga, on which he published several papers dealing with taxonomy and descriptions of new species. His work on the life-cycle of the sheep scab mite will remain a tribute to his careful and painstaking methods. There should also be mentioned his check-list of the external parasites of reptiles, birds and mammals; the amount of work and the degree of patience required for such a publication can be appreciated only by few. At the time of his death he was engaged on an ambitious monograph of the South African ticks. The work he has completed is of a high standard and will be an asset to those who follow him.

Finally, as has been said by one of his colleagues, both officially and in private life Mr. Bedford was liked by all. He had gained that wisdom that makes men kind, broadminded and unselfish, yet strong in character.

H. K. M.

Obituary

Edward Meyrick, B. A., F. R. S., F. R. E. S., F. Z. S.

Died March 31st. 1938.

It is often stated that no man is indispensable, that every person can be replaced, but this hardly holds in respect of Edward Meyrick. Not only to his family is his demise a great loss, but also to the science of which he was so to speak the father. Those who are earnestly interested in the study of *Lepidoptera* and especially the *Microlepidoptera*, will miss him as an adviser and helpful colleague, for no lepidopterist has ever had such a profound and sound knowledge of the subject or equalled Meyrick, in unselfish helpfulness.

His death came as a blow to many of us who were in correspondence with him over entomological matters and who looked forward to his constant stream of papers on the subject of which Meyrick was the recognised master. Even now we cannot realise that he is no more, that his refreshing letters have for ever ceased to come, that much of his vast store of knowledge is lost though he has saved us so much. For no entomologist, to my knowledge, has published, single handed, unsupported, and by sheer personal effort as much sound reliable information as Meyrick has.

Born on the 24th. November 1854 at Ramsbury, he was educated at Marlborough College from 1868 to 1873 and later became a distinguished classical scholar of Trinity College, Cambridge. The study of classics remained dear to him and, as one of his old colleagues states, "His devotion to science never replaced or obscured his loyalty to the classics." This is fully supported by the many thousands of names which he gave to species new to science, and one can readily understand his intolerance of barbaric names.

But from early youth Meyrick had a love for Nature and was both as a pupil and as a member of the College staff the moving spirit of the Marlborough Natural History Society. For 25 years he was the President of the latter being not only at home in entomology, but equally interested in botanical and ornithological problems. His "Handbook of the Lepidoptera of the District" (1911) shows the keen and active interest he took in this local society for whatever he undertook he did thoroughly.

From 1878—1887 he resided as a schoolmaster at Sydney and Christchurch (New Zealand) and the fauna of these places doubtless fanned to full blaze his enthusiasm for taxonomic work on the Lepidoptera; even at that time he gave preference to the Micros

as an early paper in 1878 clearly shows. From that time onwards he published important papers of a revisional nature every year, not merely catalogues with descriptions of species and genera, but the classification of groups worked out on evolutionary lines.

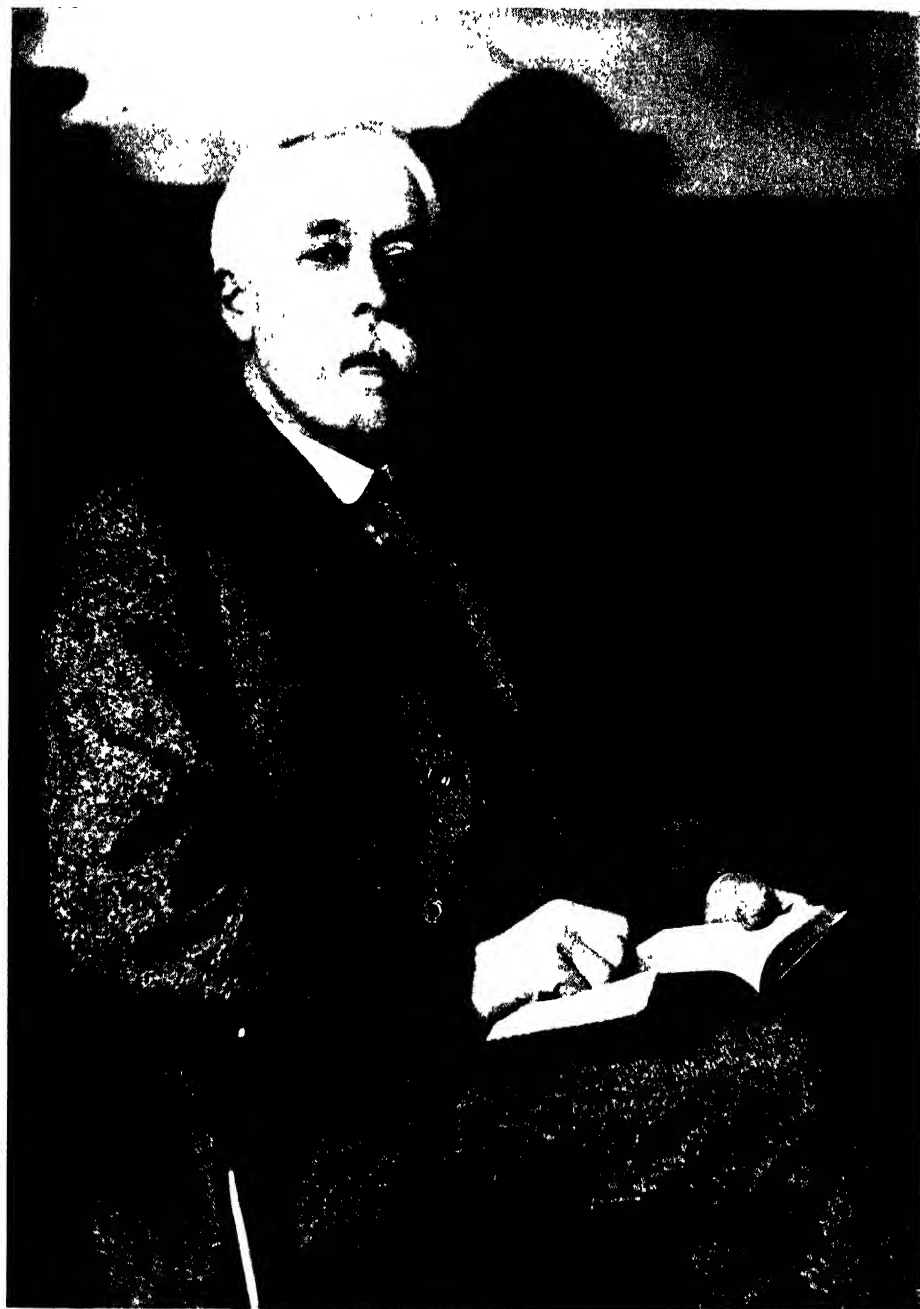
Meyrick from the very first took a keen interest in evolution and in geographical distribution from that point of view, and throughout all his work this subject formed the golden thread that held together the groups, created by him. Relation between the continents of the Southern Hemisphere was a theme on which he collected much information.

Every year, from 1875—1938 (except in 1896) he published a number of papers of great importance, each often of a size large enough to entail a year's work to most investigators. In 1883 not less than thirteen papers came out and it was with no idle boast that he wrote to me early in 1937 "I am a fast worker."

But, even though the quantity is astounding and proof of his industry, the quality of each one of his works, from the earliest to the very last, is of the highest standard; precision, and uniformity, which make for easy perusal, are the hall-marks of all Meyrick's work and show his genius for taxonomic work and his love for truthful knowledge. His laws (as given in his "Handbook of British Lepidoptera", first edition p. 10) summarize the fundamental principles worked out and applied by him in his classifications. To give a reason for every statement, to verify and, if necessary, to revise views held by himself and others in order to get at the truth was almost a religion with him; "allied to", or "related to" meant to him more than "resembles" or "looks like"; it was a statement of relationship based on a large amount of evidence, of which he was a most keen observer. Of this characteristic one of his college colleagues wrote. "We do not associate unwarranted assertion with the character of Edward Meyrick", and "... his eagle eye, which nothing seemed to escape."

After returning to England in 1887 until he retired in 1914, he was engaged in the teaching of classical languages at the Marlborough College, being at the same time a resident master. Those who know what it is to make a living as a teacher and to be a resident master at the same time must simply marvel at the amount of entomological work done during that period. More than 160 papers were prepared by him during those years, many of them being big volumes, such as his contributions to the "Genera Insectorum", his "Handbook of British Lepidoptera", "Fauna Hawaiiensis", etc. and in other papers he dealt with Micros from practically all over the world.

In 1912 Meyrick found that his contributions could not be absorbed quickly enough by the many journals to which he sent them, so he established his "Exotic Microlepidoptera", published at irregular intervals in parts, so as not to hamper the other important mono-



EDWARD MEYRICK

graphic works such as the "Genera Insectorum" on which he was engaged. Of this publication four complete volumes saw light, each of about 600 pages and volume V was published up to p. 160, when death overtook its author. This valuable publication, brimful of important information was published entirely at the author's expense from a small personal fund and, I think, at great sacrifice. Many of the copies circulated were donated by him to his correspondents and with his usual generosity he would not hear of payment for these, even though the small number of copies sold must have been relinquished at far below the cost of printing. But Meyrick thought nothing of the sacrifice of time or money where it concerned the furtherance of the science he loved. His time, ability and knowledge were available to all institutions as well as private workers who were earnestly interested in Microlepidoptera, irrespective of nationality or country. He was in every respect a true scientist of world reputation and of an international scientific outlook.

As a correspondent Meyrick was an inspiration and a stimulus. The writer had the privilege of corresponding with him as early as July 1907, and several letters were received each year, all full of interesting information and nearly always containing some personal touches as well. In his last one dated 1. II. 38 he wrote in reply to a request concerning the undertaking of some work on the Phycitids: "I realise that I cannot go on for ever; also, like all other human beings, I may de cease at any time without warning. Yet at present I am able to do as good work as ever, and wish to continue."

He had his wish; he worked up to the last and did as good work as ever. A short illness snatched him away and, although his work was not finished (it never will be, for in nature there is no end to problems), yet he left behind him a fundamental structure on which it will be safe to build further, given the same tools and material as he used. Whether any one will ever be able to carry on in the able manner of Meyrick or can ever apply a similar industry and enthusiasm, to say nothing of the knowledge, remains to be seen, but that the monument erected by Meyrick to the study of Lepidoptera will always remain an inspiration cannot be doubted.

Meyrick was an inspiration to the private worker for he has shown what a private worker can achieve, what methods should be employed when the field is vast and the means of investigation slender. The writer was more than impressed in this connection when he had the privilege in 1921 of staying at "Thornhanger" for some time, most of which was spent in Meyrick's study. A collection much smaller than one would expect of an investigator of his standing dealing with Micros from all over the world, still a collection showing the greatest care and order; what there was, was nearly all worked out and was carefully studied and the results of

his studies were tabulated in his "keys", written in a small pile of foolscap books on an almost empty desk. "No cluttering up" seemed to be the watchword of the man working at this desk! — These "keys" were used for every determination, nothing was taken for granted; constantly they were being perfected and brought up to date as more data became available. These books, given Meyrick's master mind to use them, contained all the information required to name any material that came in. Even his library though select, was smaller than one would expect, yet he had available all the information on the subject required to produce such work as he did. Such a visit was an object lesson to a fellow worker, showing how a maximum amount of work could be done with the least fuss and waste of time. It can safely be called the "Meyrick Method", unique, as was the man himself.

Every day he went for a three-or four-mile walk and these walks with him were most interesting too, the conversation being of a more personal nature. On those occasions one got to know some of the struggles he had in order to achieve what he did; how he had managed to keep his work going since retiring. All this was told in his modest, unassuming manner, as if it was the only and most natural thing to do.

For South Africa Meyrick has done more than any other worker in bringing order into the study of Microlepidoptera. When he began, 349 species had been described from South Africa, grouped in 218 genera, not including the Pyralidæ; to-day the number has been increased by him to 2079 species in 494 genera. In addition to this it should be realised that he was always willing to return the types, so that practically all the type-material is in South-Africa, a fact which future South African workers will appreciate when the extension of our knowledge demands the frequent examination of authentic material.

It was therefore as a small token of recognition of his unselfish contribution to our knowledge of the South African Micro-fauna that the South African Biological Society decided in 1927, on the day of his 73rd birthday, to award to him the eleventh Senior Captain Scott Memorial medal (See the *S. A. Journal of Nat. Hist.* vol. VI. pp. 161—166, 1928).

In his papers comprising over 400, not less than 1580 newly established genera have been founded and described by Meyrick and the number of new species must be well over 10,000. In volume I. of "Exotic Microlepidoptera" 1508 species were described as new and on that basis the five volumes alone contain over 6000 new species.

To give an adequate review of his publications is almost impossible, but what impresses one irresistibly is the solidity of the work. There is a singular uniformity in all his descriptions from the

very earliest to his most recent ones, which makes it easy to compare the one with the other and tends to assist the understanding of his adequate descriptions. He further gave similar descriptions of species described by his contemporaries and by earlier taxonomic workers, such as Walker and Felder. After he had seen the types, he readily sank his own specific names in favour of the earlier ones, even though the descriptions of the latter were unrecognisable (e.g. Walker's). He gave early attention to foodplants and life habits, an important item to the economic entomologist and he kept this up to the last. He was one of the first Lepidopterists to take an interest in the male genitalia and used these characters as early as 1885, but lack of material which could be dissected caused him to make more use of other characters in his classifications; but the characters used were applied rigidly, without preconceived theories, and tested over and over again. Meyrick was perhaps the first to point out (in 1886), the relationship between the Micropterygidæ and the Trichoptera, thus striking at the root of the origin of the Lepidoptera.

His work, though immense in quantity, is even more wonderful in its quality and, though he has departed, it will be the foundation on which many generations of Lepidopterists will be able to build.

That he did not live in vain may be some consolation to his widow and four children in their bereavement; that his work will live for as long as there are Lepidopterists, may somewhat compensate his fellow workers who mourn him.

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The early stages of *Phasis thero* Linn. (Lepidoptera, Lycaenidae)

by

DESMOND MURRAY.

The early stages of none of the thirty odd species of the genus *Phasis* (*Lycaenidae*) occurring in South Africa were known until quite recently. The food-plants being altogether unrecorded, it was difficult to trace any individual species. The majority occur at the Cape; a few others are scattered over the arid regions of the Karroo, and South West Africa and one or two occur in the Transvaal. There have been few collectors sufficiently interested to trace the early stages of this difficult group, though this knowledge will be found more and more necessary as a solution of the over-lapping of species that now undoubtedly exists.

During the last two or three years Mr. G. C. Dickson of Cape Town has by careful and painstaking observation traced the food-plants of some dozen species, and worked out the early stages in several instances, revealing some very interesting facts.

It is known that the smaller species in most cases favour plants of the family *Compositae*. The eggs are laid in clusters of four or five, thus differing from other Lycaenids, which always lay their eggs singly. In more than one case the eggs are covered with the abdominal scales, no doubt as a protection against ants; this is known to be the habit of the *Hesperidae* and many moths. The species studied within the last few years include *Phasis felthami*, *P. Wallengreni*, *P. zeuxo*, *P. chrysaor*, *P. thysebe*, *P. osbeckii*, *P. malegrida*, *P. Palmus*, and in the Transvaal *P. taikosama*, which I found uses *Felicia muricata* Ness as its foodplant.

Further, Mr. Gowan Clark of Port Elizabeth has made some fine drawings of the honey-gland and tubercles that occur in several of the above larvae, and I believe these are in the course of publication.

I was particularly anxious to find the larva of *Phasis thero*, this being one of the larger species and therefore more easily traced; it also differs considerably from the other members of the group in other respects. With this object in view, accompanied by Mr. Dickson, I sought *thero* on the Cape Flats, one of its known habitats. Trimen had recorded that the insect was generally found around the flowers of *Melanthus major* Linn., though this was not supposed to be the food-plant. At first we had little success, but later

Mr. Dickson was fortunate in observing a female ovipositing on a species of *Rhus*. From this single egg I raised a larva, feeding it on *Melianthus*, as the other plant was not available. *Melianthus* proved to be the one generally used, as several specimens were obtained from it in various stages at a later date.

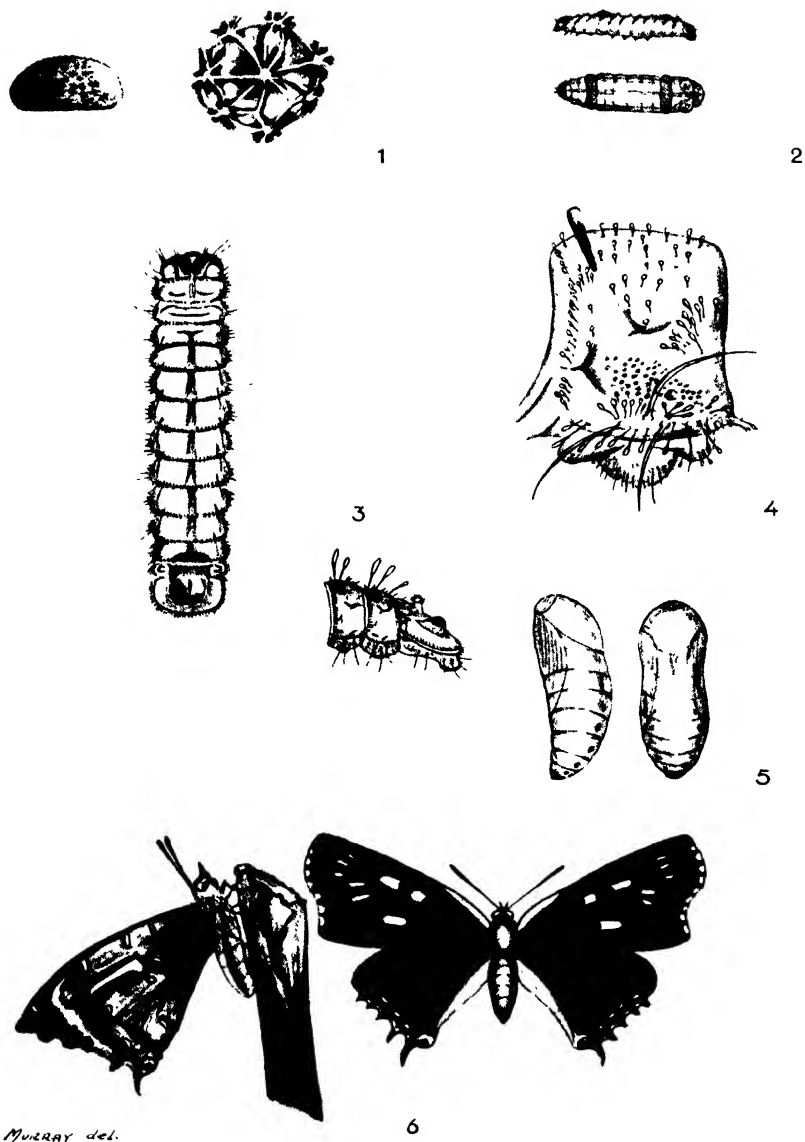
Marloth has an interesting note about food-plants in his *Flora of South Africa* (Vol. 1. p. 150): „The leaves (of *Protea speciosa*) are generally found injured by caterpillars, while hardly any of the other species are liable to such attack. The scarcity of butterflies in the Cape region may be partly due to the want of food which their larvae could find here, for almost all the indigenous plants and especially the shrubby species are well protected against the attacks of insects, either by an abundance of tannin, like most of the *Proteaceæ* or by aromatic oils, like the *Rutaceæ* or by sharp and acrid ingredients, like many *Monocotyledons*.” *Melianthus* on the other hand is a soft-leaved plant, and it proved to be the food-plant of the ro.

1. *The Egg*: is laid singly in the angle of the stem of the food-plant. This was found to be the case with those laid in the summer months; whereas those laid at the end of the season, and which would have to carry over the winter, were placed well within holes of the rough stem. The egg is dark mauve in colour with raised reticulations of a star-pattern, not deeply indented as with other species. From the egg laid on the 4th December, a larva emerged on 19th December.

2. *Larva*: on emergence measured just over 2 mm.; active. Reddish brown in colour laterally, whitish dorsally, with prominences on the 3rd and 9th segments, covered with long setae, curved forward, and much thicker at the back. After feeding, the young larva rested from the fourth day for 48 hours in the fold of a leaf on a slight web.

The second instar occurred on December 27—28; measurement 4 mm., setae larger and clubbed. The third instar occurred about ten days later; the larva came to full growth at the beginning of February, after the fourth instar; measurement then being 21 mm.; setae short and bristly laterally, short stumpy hairs dorsally along the division of the segments. Dull green in colour with dark brown to reddish markings along the sides and at the back. The growth is slow and the larva very sluggish. Those emerging in January did not come to full growth until the middle or end of March.

There are special points to note about the larva, i. e. the presence of the *honey-gland* with *tubercles* on either side, and the hard shield at the base of the body similar to that found in



MURRAY del.

1. Egg, and section enlarged. 2. Larva on emergence. 3. Full-grown larva; enlargement, showing basal shield and tubercle sheaths. 4. Sixth segment of full-grown larva, enlarged. 5. Pupa. 6. Imago, upper- and underside.

Capys alphæus, which also pupates within the stem or hard flower-head of the food-plant (*Protea*).

Many of the *Lycænids* possess the honey-gland but only certain species have the tubercles. These are very evident in the larva of *thero*. When disturbed, a "tongue" emerges from the sheath, having a rapid rotary movement; this is used on either side of the gland, as a whip to keep away unwanted guests, but not ants. The function of the tubercles has not been understood, but without doubt this is their use, as observations on several species of *Phasis* prove.

3. *Pupa*: To pupate the larva finds a hollow stem of the food-plant and makes a slight web within the stem. Sometimes two or three gather at the same place if the aperture is large enough. After resting two or three days it changes. The pupa is well guarded from attack, being within the stem, the strong basal shield filling the aperture against the *Ichneumon* fly. The larva that changed in February emerged within two weeks later; those that pupated in March and April held over until the following September, unless the weather was warm.

4. *Imago*: is dark brown in colour with orange-red spots, bases widely scaled with orange ochreous, Cilia whitish, hind-wings with tails. On the underside: the fore-wing with orange-red and silver-white spots; the hind-wing, with a conspicuous broad ray of golden-white. This species is the largest of the group, measuring up to 50 mm. in expanse. It occurs generally in September and March; it has been observed on the Cape Flats, at Paarl, Swellendam and Mossel Bay, but has not been taken in Natal or the Transvaal evidently being confined to the limited range of the food-plant.

I have stated before (Cf. *Monograph S. A. Lycænidæ-1935*) that this species (together with *P. argyraspis* and *P. sardonys*) is more closely related to *Capys* than to the rest of the group. The name *Pseudocapys* has been suggested for a new genus. The particulars of the early stages show this difference:

- (a) Eggs laid singly and not in cluster; with raised reticulations, not pitted.
- (b) Larva very closely resembles *Capys*, and food-plant not of the *Compositæ* as with other known species.
- (c) Besides this, these three species are much larger in size; the outline of wing is different; they have a five-branched radius in the fore-wing, long palpi, clavate antennæ and large anal lobe.

Corrections in the classification of two species of South African Saturniidae (Lepidoptera Heterocera)

by

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Genus *LOBOBUNÆA* Packard,

Journ. N. York Entom. Soc. IX, p. 191 (1901)

Type: *Phalæna Attacus Phædusa* Drury.

Lobobunæa angasana (Westwood). (Plate II, fig. 1, male).

- Saturnia angasana* Westwood, Proc. Zool. Soc. London, XVII, p. 52, (1849) ♀;
Angas, Caffirs Illustr. plat. Amazoolu Lep., pl. XXX, fig. 16 (1849);
Westwood, Ann. Mag. Nat. Hist. (2) V, p. 398 (1850);
Guérin-Meneville, Revue Mag. Zool. (2) II, p. 416 (1850).
Bunæa angasana (Westw.), Walker, Cat. Lep. Het. Brit. Mus. V, p. 1231
(1855) ♀;
Kirby, Trans. Ent. Soc. London I, p. 16 (1877);
id., Syn. Cat. Lep. Het. I, p. 752 (1892);
nec Bunæa cafraria ab. *angasana* (Westw.), Rothschild, Novit. Zool. II, p. 39
(1895);
nec Bunæa angasana (Westw.) (= *cafraria* ab?), Distant, Ann. Mag. Nat.
Hist. (6) XIX, pp. 390 et 391 (1897) (= *alcinoë* Cr.);
Bunæa angasana (Westw.) Distant, Insecta Transvaaliensia, p. 58 (1911)
(partim).
Bunæa cafraria ab. *angasana* (Westw.), Cockerell in Packard, Monogr. Bomb.
Moths N. Amer. III, p. 41 (1914).
Bunæa alcinoë f. *angasana* (Westw.) Gaede in Seitz, Gross-Schmett. d. Erde
XIV, p. 320 (1927); Schüssler, Lep. Cat., pars 56, p. 98 (1933).

This species, very well described by Westwood and illustrated by Angas, has evidently been misidentified by Rothschild, who referred it to *cafraria* Stoll. Distant, who at first (1897) agreed with Rothschild, due also to a misidentification (he took *alcinoë* Cr. for *angasana*), corrected his mistake in Insecta Transvaaliensia (1911). Notwithstanding this, later workers continued treating *angasana* as a form of *alcinoë* Cr. (of which *cafraria* Stoll. is a form).

I have examined five males in the collection of the Transvaal Museum, which agree completely with Westwood's original description, and have come to the following conclusions:

1. *angasana* Westwood must be reinstated as a good species quite distinct from *Bunæa alcinoë* Cr.;
2. it must be placed in the genus *Lobobunæa* Packard, as its

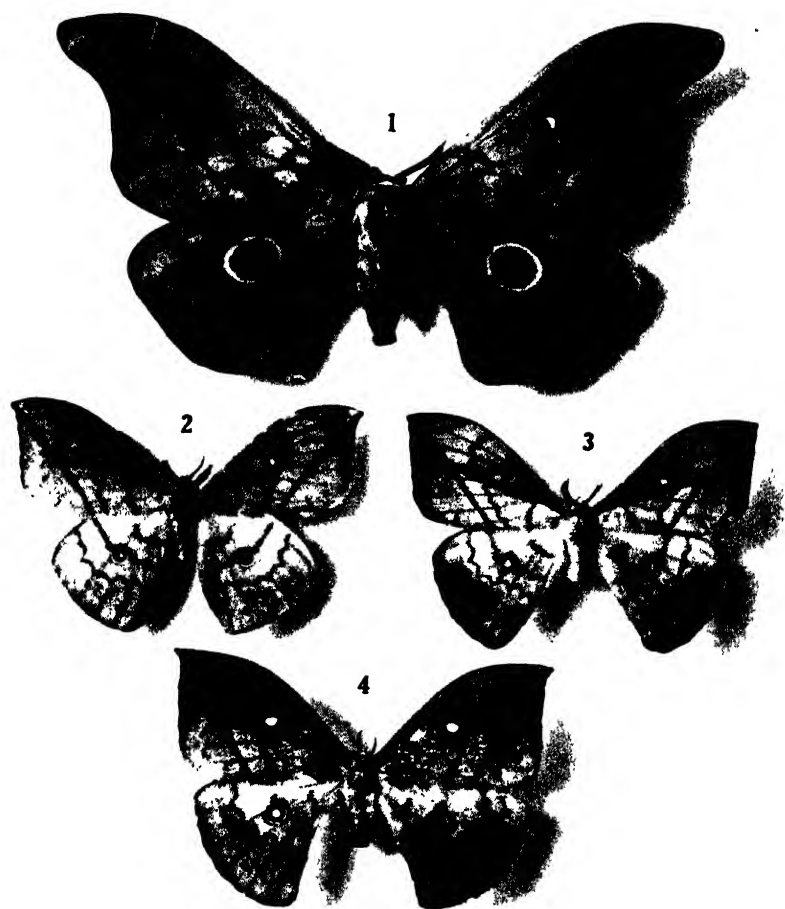


Fig. 1. *Lobobunxa angasana* (Westwood), ♂ (Nelspruit, Transvaal).
 " 2. *Pselaphichia flavivitta* (Walker), ♂ (Natal).
 " 3. *Pselaphichia flavivitta* (Walker), ♂ -form *gemmatricea* (Butler). (Chirinda forest, Southern Rhodesia).
 " 4. *Pselaphichia flavivitta* (Walker), ♀ (Malta Forest, Pietersburg District, Transvaal).

neuration clearly indicates: vein R_2 of forewing is given off from the cell before the stalk of R_4-R_5 (R_3 being absent or coincident with R_4), and not stalked with R_4-R_5 as in *Bunava* Hb. (type *caffra* Hb., which is a synonym of *caffraria* Stoll, a form of *alcinoë* Cr.).

Genus **PSELAPHELIA** Aurivillius,

Arkiv for Zoologi II (4), p. 13, fig. 19 (neuration), p. 20 (1904).

Type: *Copaxa gemmifera* Butler.

Pselaphelia flavivitta (Walker). (Plate II, figs. 2—4).

- Antheraea flavivitta* Walker, Trans. ent. Soc. London (3) I, p. 275 (1862) (Natal);
Copaxa dentifera Maassen u. Weymer, Beitr. z. Schmett. V, fig. 115 (1886) (Delagoa Bay);
Copaxa gemmifera Butler, Proc. Zool. Soc. London, p. 387 (1878) (part.);
Tagoropsis gemmifera Butler, Kirby, Syn. Cat. Lep. Het. I, p. 755 (1892).
Tagoropsis dentifera (Maassen u. Weymer), Kirby, o.c., p. 756 (1892);
Tagoropsis (?) *flavivitta* (Walker), Kirby, o.c., Appendix, p. 934 (1892);
Tagoropsis dentifera var. *conspersa* Aurivillius, Entom. Tidskrift 14, p. 203 (1893) (Delagoa Bay);
Tagoropsis (sic!) *dentifera conspersa* (Auriv.), Rothchild, Novit. Zool. II, p. 11 (1895); Silbermann, Die Seide, I, p. 328 (1906); Strand, Archiv f. Naturg. 78A, (6), p. 142 (1912).
Pselaphelia gemmifera (Butler) Aurivillius, Arkiv. f. Zoologi, pp. 13 et 20, fig. 19 (1904);
Tagoropsis flavivitta (Walker), Gaede in Seitz, Gross-Schmett. d. Erde XIV, p. 335 (1929);
Pselaphelia gemmifera (Butler), Gaede, o.c., p. 335 pl. 57 b (1929);
Pselaphelia dentifera (Maassen u. Weymer), Gaede o.c., p. 335, pl. 57a, (1929);
Pselaphelia dentifera f. *conspersa* (Auriv.) Gaede, o.c., p. 335, (1929);
Tagoropsis flavivitta (Walker), Schussler, Lepid. Cat. pars 56, p. 233 (1933);
Pselaphelia dentifera (Maassen u. Weymer), Schussler, o.c., p. 234 (1933);
Pselaphelia dentifera f. *conspersa* (Auriv.), Schussler, o.c., p. 234 (1933);
Pselaphelia gemmifera (Butler), Schussler, o.c., p. 234 (1933).

I have examined a series of over 30 males and 10 females in the collection of the Transvaal Museum, and have come to the conclusion that the synonymy given above is correct.

The females all agree well with Walker's description, which does not fit the female of *Tagoropsis flavinata*, the only species of *Tagoropsis* known from Natal. Walker states among other characters that the forewings are falcate, that the legs, particularly the forelegs, are mostly purplish rosy, and that the thorax has a broad yellow band bordered with brown in front. These are precisely the characters of the females collected by me together with males (on several occasions in copula), answering the description of Butler's *gemmifera* (Plate II fig. 3) (with a dark radial stripe along lower margin of cell to as far as the oblique dark line extending from

apex to the middle of inner margin of forewing) in the Chirinda forest, Southern Rhodesia.

Males from the coast (Durban and Delagoa Bay) sometimes show the dark radial stripe (in a male from Delagoa Bay it is fairly distinct), but the females from different localities do not show any differences except in the intensity of the ground colour which in more Southern specimens (Durban) is slightly yellowish. In higher altitudes (Chirinda forest; Nelspruit; Malta forest, Pietersburg district, Transvaal), the dark radial stripe in the males is almost general. The name *gemmifera* can therefore only stand as a varietal name. The exact course of the medial line in the hindwing varies individually within the same locality.

Maassen and Weymer's *dentifera*, which only differs from *gemmifera* in the absence of the dark radial stripe, as well as its somewhat more intensely marked variety *conspersa*, must sink to *flavivitta* Walker.

The neuration and palpi of the females answering Walker's description of *flavivitta* places them in the genus *Pselaphelia* Auri-villius, which differs from *Tagoropsis* Felder (type *flavinata* Walker) in the absence of vein R_2 of forewing (stalked with R_4 - R_5) in *Tagoropsis*; and also in the long and upturned palpi (very short in *Tagoropsis*).

My acknowledgments are due to Mr. Eugene G. Munroe, of Westmount, Que., Canada, who, during his visit to South Africa in 1935, assisted me in rearranging the Saturniidæ collection of the Transvaal Museum, and pointed out the necessity for the corrections which are the subject of the present paper.

Notes on Ceratopogonidae (Diptera Nematocera) from Southern Africa — II

by

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The genus *Alluaudomyia* was erected in 1913 by Kieffer for *imparunguis* collected by Alluaud and Jeannel in British East Africa. Since *bellus* Coq. is regarded as a synonym of *splendida* (Winn.), Malloch's *Neoceratopogon* falls away under *Alluaudomyia*. Carter, Ingram and Macfie in erecting the genus *Prionognathus*, pointed out that it was very like *Alluaudomyia*, but differed chiefly in the character of the wing microtrichia. *Prionognathus* being pre-occupied, the generic name was changed to *Thysanognathus*. Macfie (1924) in a footnote to his paper on some Egyptian midges pointed out that Hoffman had found *Thysanognathus* and *Neoceratopogon* to be congeneric. Johannsen (1934) gives *Isoeacta poeyi* Garrett as a synonym of *C. bellus* Coq.

Carter, Ingram and Macfie have given a full description of the adult of *marmoratus* and have pointed out the general resemblance of the genus to *Culicoides*. The discovery of further species of *Alluaudomyia* with short claws, and species of *Culicoides* with the first radial cell missing, have further heightened this resemblance. It appears, however, from the recent descriptions of the early stages of *needhami* and *splendida* by Thomsen (1937) that fundamental differences do exist between these two genera. Nothing is known about the habits of the adults, but judging from the structure of the claws and mouth parts, they will probably be found to be predaceous. The larvæ of *needhami* and *splendida* are said to be predaceous and cannibalistic.

Species of this genus have been described from Africa, W. Europe, India and N. America. The majority of species have so far been described from the Ethiopian region.

The types of the new species described below have been deposited in the collection of the South African Institute for Medical Research, Johannesburg.

ALLUAUDOMYIA Kieffer 1913.

1913 *Alluaudomyia* Kieffer, Voyage de C. Alluaud et R. Jeannel, Afr. Or., 12. (type *imparunguis* Kieff. 1913).

1915 *Neoceratopogon* Malloch, Bull. Ill. Lab. Nat. Hist. 11, 310.

- 1921 *Prionognathus* Carter, Ingram and Macfie, Ann. trop. Med. Parasit., 14, 309.
 1922 *Thysanognathus* Ingram and Macfie, Ann. trop. Med. Parasit., 16, 244.
 1925 *Isoecacta* Garrett, Seventy New Diptera, 9.

A List of the Species.

- 1922 *A. albopictus* (Ingram and Macfie), Ann. trop. Med. Parasit., 16, 244. (Dodowah, Gold Coast). ♂, ♀.
 1913 *A. imparunguis* Kieffer, Voyage de C. Alluaud et R. Jeannel, Afr. Or., 12. (Nairobi, British East Africa). ♀.
 1921 *A. maculipennis* (Carter, Ingram and Macfie), Ann. trop. Med. parasit., 14, 316. (Accra, Gold Coast). ♀.
 1925 *A. gloriosa* Kieffer, Arch. Inst. Pasteur Algér., 3, 422. (Austria). ♀.
 1936 *A. maculosa* De Meillon, Publ. S. Afr. Inst. med. Res., 7, 172. (Eshowe, Zululand) ♀. 1937 *ibid.* 7, 391. Pharynx.
 1921 *A. maculithorax* (Carter, Ingram and Macfie), Ann. trop. Med. Parasit., 14, 319. (Accra; Gold Coast) ♂. 1935, Goetghebuer, Rev. Zool. Bot. afr., 27, 33. (Rutshuru, Belgian Congo) ♀.
 1921 *A. marmoratus* (Carter, Ingram and Macfie), Ann. trop. Med. Parasit., 14, 312. (Accra, Gold Coast; Bonny Nigeria) ♂.
 1922 *A. melanostictus* (Ingram and Macfie), Ann. trop. Med. Parasit., 16, 248. (Accra, Gold Coast) ♂. 1924, Macfie, Bull. ent. Res., 15, 66. (Ayat, Beni-Hassan, Egypt) ♀.
 1923 *A. monostictus* (Ingram and Macfie), Bull. ent. Res., 14, 60. (Zanzibar) ♀.
 1935 *A. needhami* Thomsen, J. N. Y. ent. Soc., 43, 287. (New York) ♂♀. 1937, Thomsen, Mem. Cornell agric. Exp. Sta., 210, 72. Egg, larva and pupa.
 1924 *A. nilogenes* (Kieffer), Bull. Soc. R. Ent., Egypt, 262. (Maadi, Egypt) ♂.
 1921 *A. pseudomaculipennis* (Carter, Ingram and Macfie), Ann. trop. Med. Parasit., 14, 318. (Accra, Gold Coast) ♀.
 1936 *A. senta* De Meillon, Publ. S. Afr. Inst. med. Res. 7, 175. (Eshowe, Zululand) ♂.
 1852 *A. splendida* (Winnertz, Linnea Entom., 6, 47. (Germany) ♂.
 1902 *Ceratopogon bellus* Coq., Proc. U. S. nat. Mus., 25, 87. (U. S. A.) ♂.
 1915 *Neoceratopogon bellus* (Coq.), Malloch, Bull. Ill. Lab. nat. Hist., 11, 310. (Illinois, U. S. A.) ♂♀.
 1925, Kieffer, Faune Fr., 11, 88 (England, Austria).

- 1935, Thomsen, J. N. Y. ent. Soc., 43, 288. (New York, U. S. A.) ♂♀.
 1937, Thomsen, Mem. Cornell agric. Exp. Sta., 210, 73. New York, U. S. A.). Larva and pupa.
 1913 A. *xanthocoma* (Kieffer), Rec. Indian Mus., 9, 182. (Orissa, India) ♂. 1925, (Kieffer), Arch. Inst. Pasteur Algér., 3, 422. 1932, Edwards, Rec. Indian Mus., 34, 178. (Chilka Lake, India).

A Key to the species of *Alluaudomyia*.

- 1 Thorax spotted 9.
 " not spotted 2.
- 2 Eyes hairy 3.
 " bare 5.
- 3 Some leg segments armed *senta*.
 Legs unarmed 4.
- 4 Claws of hind leg of female subequal *monostictus*.
 " " " " " " unequal *congolensis* sp. nov.
- 5 Wing with about eight spots 6.
 " " 2—3 spots 7.
- 6 Mesonotum creamy, dark wing spots well defined not surrounded by pigment *natalensis* sp. nov.
 Mesonotum brown with grey patches, dark wing spots ill-defined, white pigment present *wansoni* sp. nov.
- 7 Wing with a spot on the lower branch of the median *xanthocoma*.
 Wing without such a spot 8.
- 8 Female claws equal *marmoratus*.
 " " unequal *albopictus*, *imparunguis*.
- 9 Wing with four spots in the median cell *nilogenes*.
 " " at most one spot in the median cell 10.
- 10 Wing with two or three prominent spots 11.
 " " six to eight " " 12.
- 11 Anal cell with numerous macrotrichia *gloriosa*.
 " " bare or nearly so *maculithorax*.
- 12 Large spots on the veins only 13.
 Some spots on the wing field as well 15.
- 13 No large spot on M₁ *maculosa*.
 A large spot present on M₁ 14.
- 14 In the female macrotrichia dense, evenly spread; in the male parameres shorter than side-pieces *splendida*.
 Macrotrichia in female less dense, arranged along the veins; parameres as long as the side-pieces *needhami*
- 15 Wing with nine to ten spots or more *melanostictus*.
 Wing with six or less spots 16.

- 16 Small species, wing length 0.85 mm.; scutellum with two central bristles *pseudomaculipennis*.
 Larger species, wing length 1.1 mm.; scutellum with four central bristles *maculipennis*.

There appears to be very little to separate *albopictus* and *imparunguis*. Kieffer's description, however, is very inadequate. According to that author *nilogenes* has four dark spots in the median cell; he says: „2 dans la moitié distale de la cellule discoidale antérieure et 2 autres, presque ponctiformes, dans sa moitié basale” if he was mistaken and the spots really occur on the branches of the median and not in the cell, then *nilogenes*, described from a male, must be very like *melanostictus* also described from Egypt. Thomsen does not state whether the eyes of *needhami* are hairy or not; I take it that the former condition holds.

DESCRIPTIONS OF NEW SPECIES

Alluaudomyia wansonii sp. nov.

Female.

A brownish species with ill-defined pale markings on the mesonotum; wings very hairy with dark spots surrounded by a white pigment. *Head* — Vertex, clypeus and proboscis very dark brown; pharynx as described by the writer for the genus, cornua very long. *Eyes* — Touching above, bare. *Palps* — The relative lengths of the segments are: — III 6, IV 5, V 9; III not swollen, with a small sensory pit. *Antennæ* — (Fig. 1a) Tori dark brown rest of the segments paler but each definitely darkened apically; the relative lengths and greatest widths of the segments are:

	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
L	10	6	6	6	7	7	8	8	10	10	11	12	15
W	5	4	4	4	4	4	4	4	4	4	3	4	4

Thorax — Mesonotum brownish with some ill-defined pale markings, not spotted; pleuræ largely dark brown; halteres creamy yellow; postnotum dark in the middle, paler laterally; scutellum brownish medianally yellow laterally with a pair of central bristles. *Wing* — (Fig. 1b). Provided with two moderately well defined dark spots one on the end of the costa and the other on the cross vein and about seven ill-defined dark spots on the rest of the wing, these surrounded by a whitish opaque pigment; distal half of the wing very densely clothed with macrotrichia, proximal half nearly bare; alula bare; squama with a single hair.

longer on the anterior legs and less than half as long on the hind legs; unarmed. *Abdomen* — Largely dark brown, but distal tergites edged with creamy pigment; cerci creamy; *Spermatheca* — Single, pyriform, moderately well pigmented, large, measuring at least 108μ across but partly collapsed so no accurate measurements can be given. I female, Matadi, Belgian Congo (M. Wanson) 22.10.37.

Alluaudomyia congolensis sp. nov.

Female.

A brownish species without any distinct markings; halteres with creamy coloured crowns and terminal abdominal segments with some creamy pigment. *Head* — Vertex grey; clypeus and mouth parts brown; pharynx as described for the genus by the writer, cornua very long. *Eyes* — Narrowly separated above, intensely hairy. *Palps* — The relative lengths of the segments are; — III 8, IV 5, V 9; III not distinctly swollen, with a small sensory pit. *Antennae* — (Fig. 2a). Tori brown, other segments pale basally. brown apically; terminal segment without a style; the relative lengths and greatest widths of the segments are; —

L	9	5	5	6	7	7	3	3	3	3	3	3	4
W	5	4	4	4	3	3	3	3	3	3	3	3	4

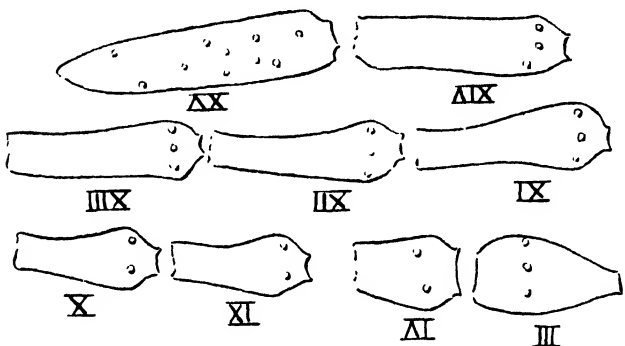
Thorax — Mesonotum grey but front and area immediately surrounding the mesonotal pits brown; pleurae dark brown; halteres creamy; postnotum broadly brown in the middle yellowish laterally; scutellum broadly brown medially and yellowish laterally with four bristles on the median area. *Wing* — (Fig. 2b) With a single prominent brown spot enveloping the end of the costa; alula bare; squama with a single hair; the wing measurements are: —

mm.	Internal measurements mm.	Measured from the arculus mm.						
Width	1st R cell	2nd R cell	Total length	Costa	Base of the cross vein	fcu	Cu ₁	fM
0.42	—	0.13	1.0	0.54	0.22	0.44	0.76	0.42

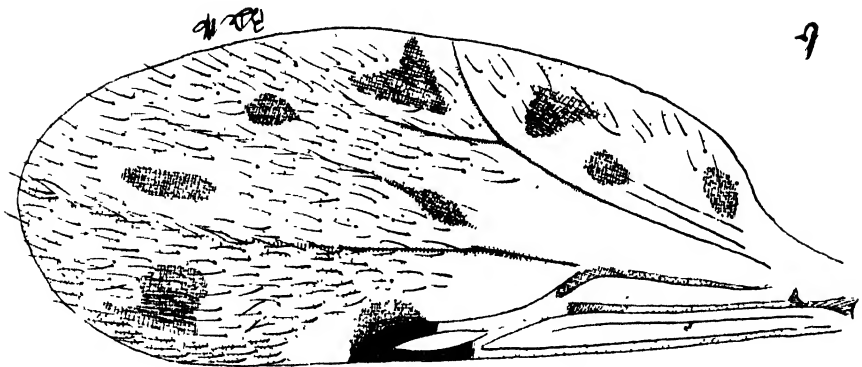
Legs — Largely pale brown with dark knee-spots; apex of the hind tibia and whole of the first hind tarsus dark; unarmed; claws unequal on all legs, the longer talon on the fore legs about as long as

mm.	Internal measurements				Measured from the arcus mm.				
Width	1st R cell	2nd R cell	Total length	Costa	R ₁	Base of cross vein	fCu	Cu ₁	fM
0.4	—	0.16	0.9	0.5	—	0.24	0.38	0.48	0.36

Legs — Largely brown; all femora with a narrow sub-apical pale band; tibiae with a narrow sub-apical and sub-basal pale band; tarsi pale brown except the first hind tarsus which is somewhat darker; claws unequal on all legs, the longer talon about as long as the fifth tarsal segment on the fore and mid legs, slightly shorter on the hind legs, the shorter talon more than half as long as the



a.



b.

Fig. 1. *Aluandomyia wansonii* sp. nov.: a. antennal segments of female; b. female wing (fringe not shown).

the fifth tarsal segment, on the other legs slightly shorter; the shorter talon more than half the length of the longer on the fore legs, shorter on the others. *Abdomen* — Mainly dark brown but with apical tergites, apices of basal tergites and cerci with creamy pigment; sternites apparently wholly dark brown *Spermathecae* — Two,

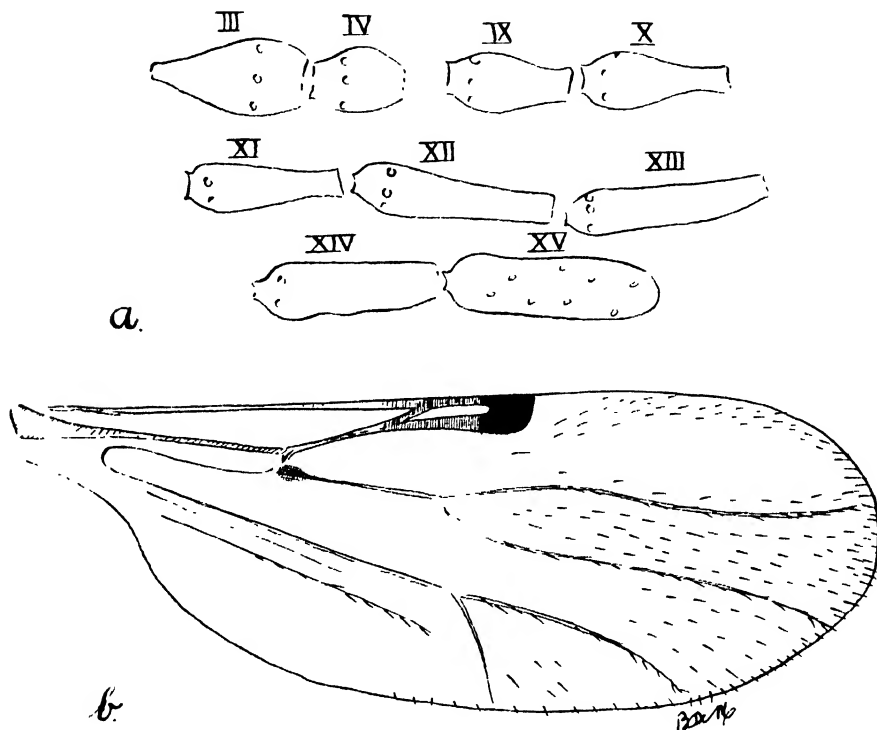


Fig. 2. *Alluaudomyia congolensis* sp. nov.: a. female antennal segments; b. female wing (fringe not shown).

pyriform, slightly pigmented, unfortunately collapsed, so no accurate measurements can be given. One female, Matadi, Belgian Congo, 22.10.37 (Coll. M. Wanson).

In general appearance this species is like *albopictus* but there are no silvery markings on the mesonotum and the cubital and anal cells of the wings are provided with macrotrichia; the hairy eyes place it near *monostictus* but the unequal claws make it easily separable.

Alluaudomyia natalensis sp. nov.**Female.**

A strikingly coloured midge with spotted wings, creamy mesonotum and abdomen; scutellum and halteres largely creamy and legs distinctly banded. *Head* — Vertex creamy; clypeus and mouth parts very dark brown; pharynx as described for the genus by the writer. *Eyes* — Narrowly separated, bare except along the inner margins. *Palps* — The relative lengths of the segments are: — II 8, III 10, IV 10, V 16; III not swollen, provided with a sensory pit. *Antennæ* — (Fig. 3a) Tori dark brown rest of the segments paler; the relative lengths and greatest widths of the segments are: —

	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
L	14	10	10	11	11	11	12	12	15	15	14	13	18
W	7	6	5	5	5	5	5	5	5	5	5	5	6

Thorax — Creamy throughout without any brown spots; pleuræ very dark brown; postnotum dark medially and creamy laterally; halteres with waxy white crowns; scutellum creamy but narrowly dark in the middle with four median dark bristles. *Wing* — (Fig. 3b) With eight dark spots as follows; — one large over the end of the costa, one diffuse over the cross vein, one very small at the apex of M_1 , one large at the base and one small at the apex of M_2 , one small at the apices of Cu_1 , Cu_2 and the anal vein; well supplied with macrotrichia; alula bare.

mm.	Internal measurements mm.		Measured from the arculus mm.						
	1st R cell	2nd R cell	Total length	Costa	R_1	Base of cross vein	fCu	Cu_1	fM
0.7	—	—	1.6	1.0	—	0.46	0.7	1.3	0.76

Legs: — Fore femur and tibia dark brown with a prominent knee spot, tarsi pale brown; apical third of the mid femur and basal third of the tibia yellowish, knee spot dark brown, tarsi pale brown; apical quarter of the hind femur and basal half of the tibia yellowish, in addition tibia with a narrow sub-apical pale band, first tarsus dark brown rest slightly infuscated; claws very unequal on all legs, the longer talon being about as long as the fifth tarsal segment and the shorter one about half as long; fourth tarsi cordi-

form; all leg segments unarmed except for a small apical spine on tarsi I—III of the mid legs. *Abdomen* — Two or three basal tergites

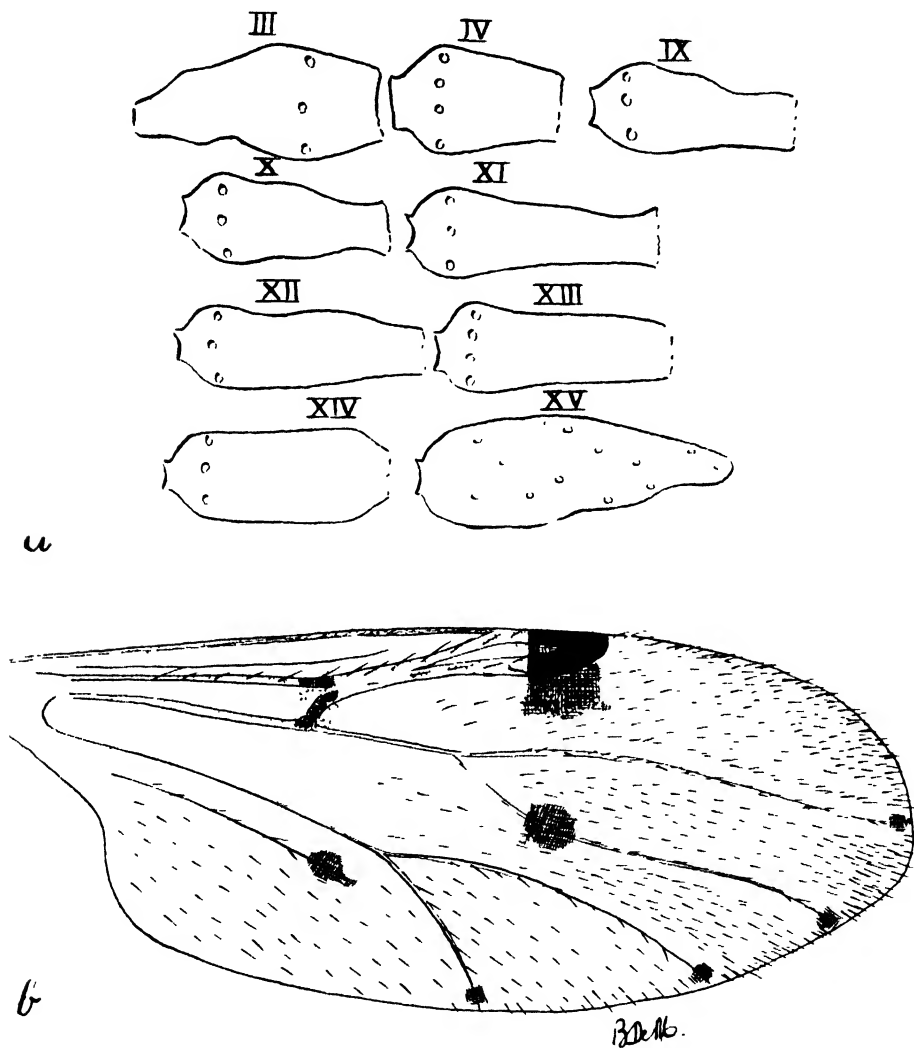


Fig. 3. *Alluaudomyia natalensis* sp. nov.: a. female antennal segments; b. female wing. (fringe not shown).

brownish rest creamy; sternites dark brown throughout. *Spermatheca* — Single, lightly pigmented, more or less pear-shaped and

measuring $92 \mu \times 72 \mu$. I female hatched from a pupa collected in a pond, Empangeni, Zululand, 16.7.38.

This species comes near *marmoratus* but is easily separable by the unequal claws and yellowish mesonotum.

Alluaudomyia senta De Meill.

Female.

A dark brown medium sized species, the most striking features being a dark spot at the end of the costa, the waxy white halteres and the yellow scutellum. Head—Vertex dark brown; clypeus clear brown; mouth parts dark brown. *Eyes*—Separated above, hairy. *Palps*—The relative lengths of the segments are:—II + III 20, IV 10, V 10; II & III imperfectly separated; III moderately swollen, with a sensory pit. *Antennæ*—Tori dark brown rest of the segments paler; the relative lengths and greatest widths of the segments are:—

	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
L	11	10	10	11	11	11	11	11	11	12	15	15	20
W	7	6	6	5	5	5	5	5	5	5	5	5	5

Thorax—Mesonotum very dark brown, moderately shiny, but shoulders and anterior portion between the mesonotal pits light brown almost yellow; pleuræ dark brown; postnotum very dark brown; halteres with waxy white crowns; scutellum dark medially, yellowish laterally with two central and a lateral bristle on each side. *Wing*—With a single black spot over the end of the costa; distal half of the wing well supplied with macrotrichia, none on the basal half; alula bare or possibly with a single hair, in the male there are three or four hairs; squama with a single hair.

mm.	Internal measurements mm.		Measured from the arculus mm.						
Width	1st R cell	2nd R cell	Total length	Costa	R ₁	Base of cross vein	fCu	Cu ₁	fM
0.5	—	0.1	1.2	0.7	0.6	0.46	0.5	0.96	0.52

Legs—Fore and mid legs largely pale brown or straw coloured; hind femur dark brown, hind tibia with a median dark brown band; fore and hind tibiæ with a prominent black spine apically; first hind tarsus with a heavy black spine basally and a slightly smaller one apically; claws equal on the mid and fore legs where they are about

half as long as the fifth tarsal segment, on the hind legs they are unequal, one talon being slightly shorter than the fifth tarsal segment and the other about half as long. *Abdomen* — Dark brown, tergites and sternites paler apically; cerci yellow and contrasting strongly with the rest of the abdomen. *Spermathecae* — Two, approximately subequal, oval, heavily pigmented, measuring $88\ \mu \times 36\ \mu$; a small portion of the duct of each pigmented; there appears to be a third spermatheca lying under one of the others and measuring $28\ \mu \times 4\ \mu$. One female taken at light Eshowe, Zululand, 7.1.38.

In my original description of the male of this species I suggested that it might be *monostictus* Ing. & Macfie, of which only the female is known; the present specimen, however, shows that the two are quite distinct.

The status of *Wohlfahrtia euvittata* Vill. (Diptera, Sarcophagidae) as a parasite of the brown locust

by

H. A. D. VAN SCHALKWIJK, M. Sc.

Introduction.

At times when bands of hoppers of the phase *gregaria* of the brown locust are prevalent in the Karroo, locust officers and farmers frequently find hoppers dying as a result of the attack of fly maggots. The presence of the maggots in the hoppers naturally attracts a good deal of attention, and the Department of Agriculture is often asked whether these natural enemies could not be enlisted in the fight against the locust.

Many years ago frequent reports about the activities of dipterous parasites in locusts were published in newspapers in the Cape Colony. The first definite statement with regard to the possible economic importance of the fly now known as *Wohlfahrtia euvittata* Vill., was published by Bairstow (1894). About 1892 Mr. S. D. Bairstow sent some specimens of the fly to the government entomologist, Mr. L. Péringuey, for identification. He was informed that specimens sent to M. Bigot about 7 or 8 years before by Péringuey had been named *Cynomia pictifacies* (Bigot) but that no scientific description had been published under this name. Bairstow published two accounts of all the facts then known in the *Agricultural Journal of the Cape of Good Hope*.

During one of Schultze's expeditions (1903) some specimens of what is presumed to be the same species were collected in South West Africa, and identified by Bezzi as *Disjunctio brunnipalpis* (Macq.) In 1920 Villeneuve, after comparing the description of Bezzi with the type specimen of Macquart in the Paris Museum, published the following statement: —

„Sur *Disjunctio brunnipalpis* (Macq.) Bezzi.

Sous ce nom, Bezzi (L. Schultze, Forschungsreise im westlichen und zentralen Süd-Afrika, 1908, p. 187) signale et décrit parfaitement une espèce du genre *Wohlfahrtia* qu'il caractérise par «Thorax-rücken mit 3 breiten schwarzen Längsstreifen, der mittlere auf das Schildchen fortgesetzt».

Cette espèce, commune dans le Sud-Africain, ne correspond ni au type de Macquart, conservé au Muséum de Paris, ni à la description. Macquart, en effet, s'exprime comme suit: «Thorax

à bandes noires peu marquées ». Aussi convient-il de remplacer le nom donné à tort par Bezzi par celui très approprié que nous proposons, à savoir *Wohlfahrtia euvittata* n. sp."

Although the name *brunnipalpis* was formerly thought to be correct for this species, material sent to the Imperial Institute of Entomology by the Entomological Section in recent years has been identified as *W. euvittata* Vill. There may be some doubt as to whether Villeneuve was justified in erecting a new species, but to avoid confusion it is thought best to retain the name *euvittata* Vill. for the present, until a competent specialist has the opportunity of re-examining the types.

Since the economic importance of this natural enemy of locusts has often been stressed, and many suggestions have been made to the effect that the flies should be bred artificially and used against locusts, an attempt is made in this paper to define the status of the fly and its general economic importance.

Distribution.

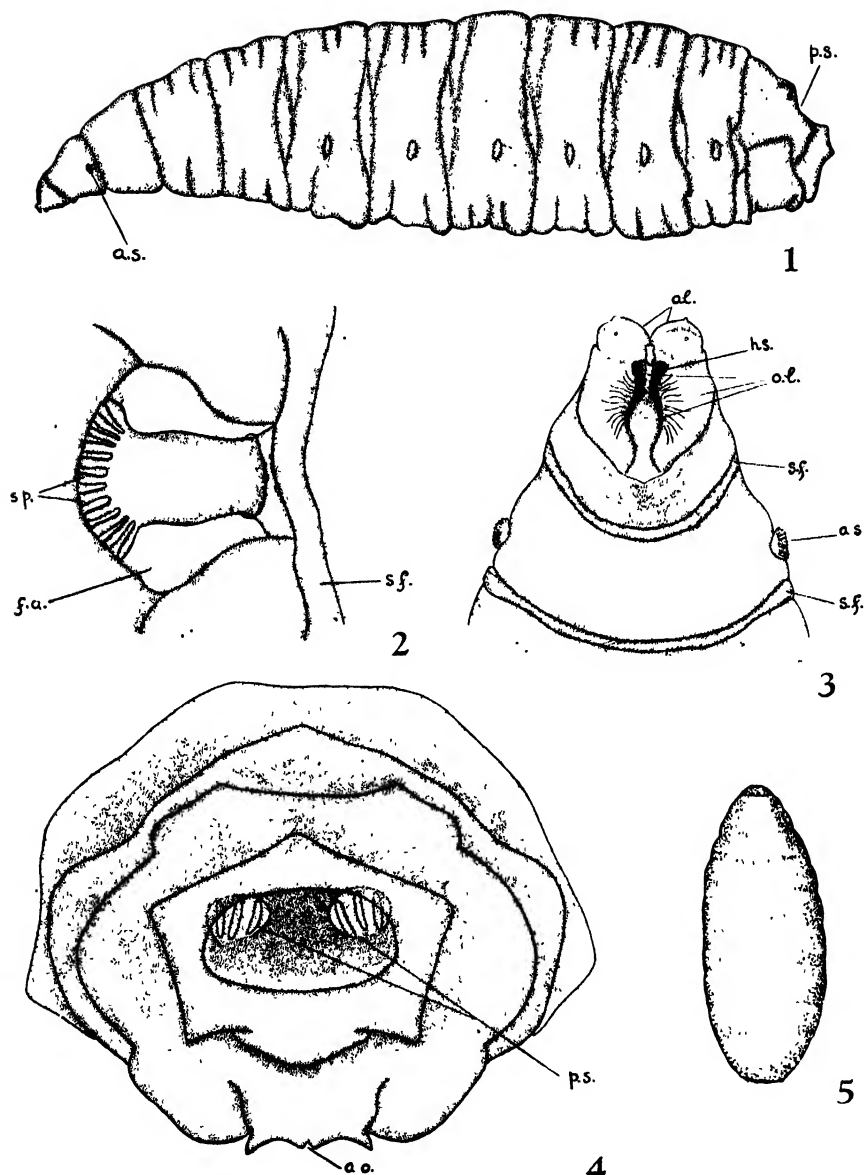
The area in which the fly is normally found is located in the north-western parts of the Cape Province, the Orange Free State, South West Africa and Bechuanaland. This distribution coincides with the area in which the brown locust is always present in the solitary or in the swarm phase.

Description.

1. Larva.

At the time of larviposition the larvae are about 4 mm. in length and 1 mm. wide. They grow very quickly, and when full grown after 4 to 6 days the body is about 23 mm. long and 7 mm. wide at the caudal end; the wide segments at the caudal end gradually taper to a point at the oral end. In all stages of growth the larvae are cylindrical and of a shiny creamy white colour. (Fig. 1).

The oral segment bears two rounded lobes at its anterior end; each lobe is subdivided into an upper and lower half with a papilla on each half. (Fig. 3). The buccal cavity, which opens on the ventral side of the segment, is surrounded by four flattened lobes, two lateral, one posterior and one anterior; the two lateral lobes are rather large and have a transversely grooved appearance; the posterior lobe is spoon-shaped and projects between the lateral lobes; the small anterior lobe is more or less rectangular. The two black, strongly sclerotized oral hooks are curved downwards and outwards; they have sharp points, which are more apparent when seen from the lateral aspect and are hinged to the anterior part of the cephalopharyngeal skeleton.



Figs. 1—4: Full-grown larva of *Wohlfahrtia euvittata* Vill.
 1. Lateral aspect of larva. 2. Anterior spiracular process. 3. Anterior end, ventral aspect. 4. Dorso-caudal aspect of posterior extremity.

Fig. 5: Puparium of *W. euvittata*.

a.l. anterior lobes; a.o. anal orifice; a.s. anterior spiracle; f.a. fleshy appendage; h.s. hooks; o.l. oral lobes; p.s. posterior spiracles; s.f. segmental fold; s.p. spiracular papillæ.

(Figs. 1—4: H. A. D. v. S. del. Fig. 5: M. E. Moberly del.)

Growing out laterally from the posterior margin of the second segment are the two anterior spiracular processes, embedded in fleshy appendages, one on each side. (Figs. 2 and 3). The processes, which are weakly sclerotized, are more or less hand-shaped, longer than broad, and each bears eleven small cone-shaped spiracular papillæ, which project like short fingers. The two posterior spiracles are located close together, in a transversely elongated oval depression on the obliquely truncate dorsal aspect of the last segment. (Fig. 4). Each spiracle is surrounded by an incomplete sclerotic ring which is open on the posterior side. Three sclerotized parallel spiracular slits lie in each of these incomplete rings in a dorso-ventral direction; the central slit is straight and the lateral ones are slightly curved outwards.

A number of soft white processes, which are more or less nipple-shaped, are situated on the dorsal and lateral aspects of the last segment. Two are situated on the dorso-frontal fold of the spiracular depression and two on its ventro-posterior fold. The greater part of the body of the larva is more or less smooth, but small spinules are located in definite bands at the anterior margins of all the segments, and also in a small area caudad of the mouth cavity. The spinule bands on the tenth and eleventh segments are restricted to the lower side. These spinule bands have not been closely investigated by the writer.

The larvæ of *W. euvittata* cannot be distinguished from other Sarcophagid larvæ such as those of *Sarcophaga hæmorrhoidalis* by a superficial examination, although a very detailed microscopic examination may show definite specific characters. Any Sarcophagid larvæ found in locusts in the field will therefore have to be reared to the adult stage before an exact determination of the species can be made.

2. Puparium.

The puparium, which is more or less barrel-shaped, is about 10 to 11 mm. long and 4 mm. wide at the middle region; the anterior end is slightly more pointed than the posterior end; the colour varies from light to dark reddish brown. (Fig. 5). The surface of the outer cuticle of the puparium ordinarily appears satiny smooth, with the larval segmentation showing faintly. The anal opening, the dorsal depression in which the posterior spiracles are embedded, the anterior lateral spiracles, and the anterior ventral oral opening of the larva are still visible; these larval structures are sclerotized like the rest of the pupal covering. When viewed under the microscope, the outer cuticle appears wrinkled, with the folds of the wrinkles running parallel to the segmentation lines. No other obvious characters are visible on the puparium.

3. Adult.

The adult *W. euvittata* flies are rather large, the length of the body varying from 10 to 15 mm. and the width over the thorax from 4 to 5 mm. (Fig. 6).

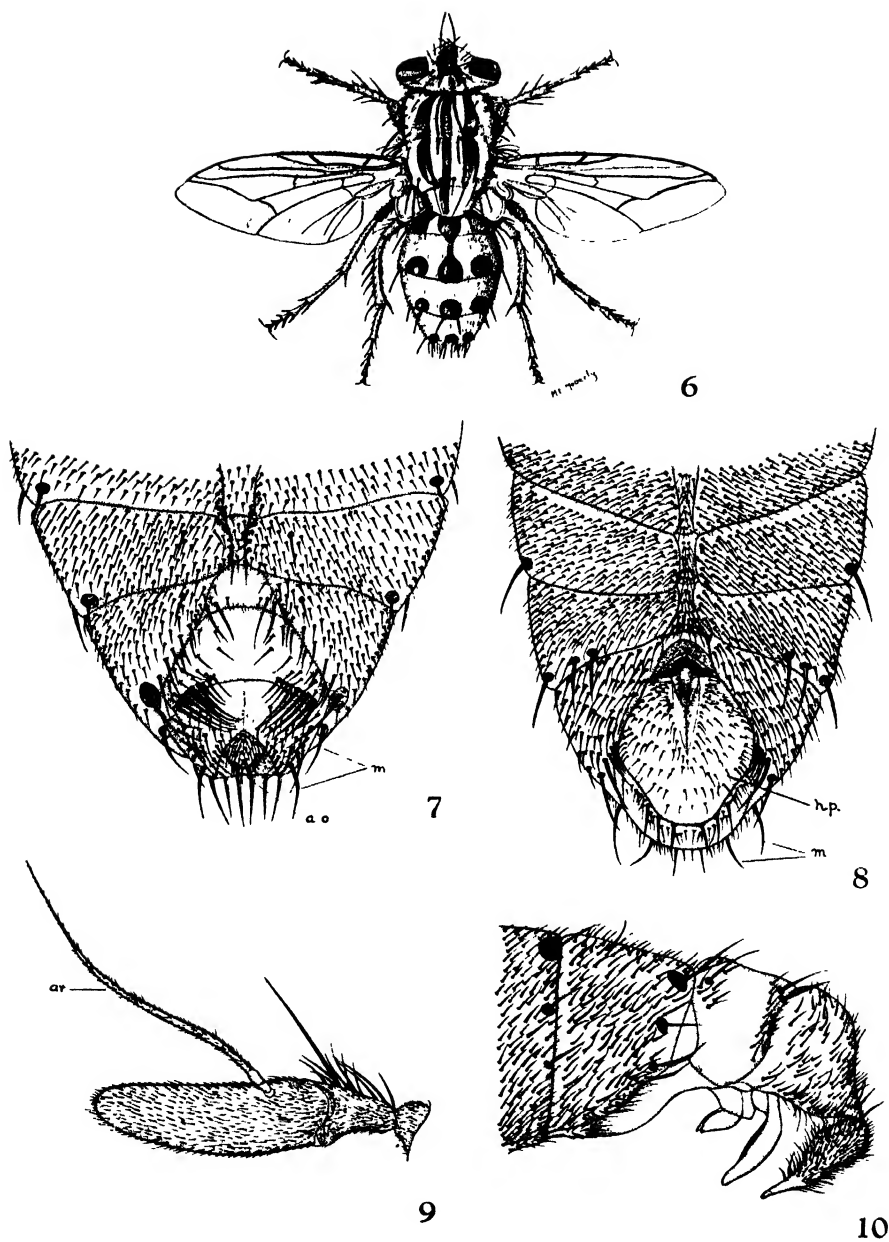
Head. Frons narrow anteriorly and gradually widening to anterior margin of eyes; brownish on vertex, becoming silvery with a slight yellow cast lower down, extending along the anterior orbit to the ventral corner of the eyes. The frontal stripe, which is dark brown and rectangular in shape, extends backwards between the eyes, and forks on either side of the slightly raised, silvery ocellar triangle. The compound eyes are large and dark brown, occupying the greater part of the head. The genæ are black, while the posterior region of the cranium is silvery, with patches of black. The antennæ, which lie in the facial groove, each consist of three segments and an arista; the distal segment is the largest and bears the arista on the dorsal side. The second segment, which is about one-third of the length of the third segment, has a differentiated bristle or macrochæta dorsally near its distal margin.

Differentiated bristles or macrochætæ of varying size and thickness are found distributed on the head as follows: —

(I). One stout bristle, vibrissa, on either side of the epistoma. (II). A row of about 15 facial bristles on either side of the face laterad of the antennæ. (III). A row of thirteen frontal bristles in front of the ocelli on either side, laterad of the frontal suture and extending to the base of the antennæ. (IV). One pair of ocellar bristles within the ocellar triangle. (V). Two pairs of post-vertical bristles behind the ocellar triangle. (VI). One pair of vertical bristles on either side between, but slightly behind, the ocellar triangle and the posterior dorsal corner of the eyes. (VII). In the female three smaller bristles, halfway between the eye and frontal stripe and almost parallel with the row of frontal bristles (absent in male). (VIII). A row of postorbital bristles are situated almost parallel with the posterior margin of the eye.

The female head differs from that of the male in having the eyes more widely separated dorsally. The space between the frontal stripe and the margin of the eye in the male is about one fourth of the same space in the female. The eyes of the male are very obviously larger than those of the female; the posterior extremities of the forked frontal stripe are pointed in the female, whereas those of the male are broad and of the same width throughout.

Thorax: The dorsal aspect of the thorax, the visible part of which consists of the greatly enlarged mesonotum and the calli, is shield-shaped, and wider at the anterior end. The mesonotum is clearly divided into the prescutum, scutum and scutellum; the humeral,



Figs. 6—10: *Wohlfahrtia eurittata* Vill.

6. Adult female. 7. Female: ventral aspect of abdomen. 8. Male: ventral aspect of abdomen. 9. Male: antenna. 10. Male: lateral aspect of terminalia. a.o. anal orifice; a.r. arista; h.p. hypopygium; m. macrochaetae.

Fig. 6: M. E. Moberly del. Figs. 7—10 H. A. D. v. S. del.)

pre-alar and post-alar calli are situated on either side. (Imms 1934). Three broad black stripes, which become broader towards the posterior margin of the divisions, run length-wise over the thorax, the two outer ones stopping at the posterior margin of the scutum, while the middle one extends to the posterior margin of the scutellum. Two additional, narrow, variable black lines on either side of the broader median stripe run the whole length of the prescutum, and part of the length of the scutum. The rest of the dorsal surface appears silvery.

Three humeral bristles are found on each humeral callus, two noto-pleural bristles on each of the pre-alar calli, and two post-alar bristles on each of the post-alar calli. Only one presutural bristle is situated on either side of the prescutum near the margin of the pre-alar callus; three supra-alar bristles near the root of the wing on the lower lateral margin of the scutum; one intra-alar bristle near margin between scutum and post-alar calli; one dorso-central and one acrostichal on either side of centre of mesonotum; eight scutellar bristles on the margin of the scutellum, two being slightly anterior to the others.

Laterally: immediately above each of the coxæ of the forelegs is one propleural bristle; six mesopleural bristles on the posterior margins of the mesopleura, and one at the lower anterior side; two sternopleural bristles near the dorsal margin of the sternopleura; six bristles on the hypopleura; six bristles on the metapleura.

Abdomen: Five segments, of which only four are visible in figure 6, are apparent dorsally. The most striking characteristic of the abdomen is the series of large black dots situated dorsally and laterally in rows of seven on the first four segments, while the rest of the surface has a grey silvery-white colour; the genital segment, which is very small in the female, and the hypopygium in the male are reddish brown. The black spots on the first segment are elongated posteriorly, the median one uniting with an anterior elongation of the median spot on the second segment to form a dumb-bell-shaped figure; the others on the second segment are circular. On the third and fourth segments the spots are all rounded, the three dorsal ones being the largest. The lateral spots not visible in fig. 6 are much smaller than those on the dorsal side. On the third and fourth segments two marginal bristles are found in each large black spot, and one on each of the lateral black spots not visible in fig. 6. In forty-six specimens examined, the black dots show very little variation, only one female having irregularly placed spots between the others.

On the rim of the last reddish brown segment in the female, twenty stout marginal bristles are situated dorsally. On the curved first segment of the hypopygium of the male four bristles (macro-

chaetæ are found, and eight on the posterior margin of the same segment.

On the ventral side the whole body of the fly is greyish black, with the exception of the last three visible sternal segments in the female, and the hypopygium of the male, which are reddish brown.

The hypopygium, or external sexual appendage, of the male provides the best character for distinguishing between the two sexes, the female having no specially developed external sexual appendage. The whole body of both sexes is covered with bristles, those of the male being long, particularly on the ventral side, while those of the female are short and close to the body; the legs, which are black in colour, are also covered with large and small bristles.

The adult *W. euvittata* flies differ very markedly from the known other South African species of Sarcophagidæ in general build of body, and chaetotaxy; the most obvious distinguishing character is the presence of the clear-cut distinctive black dots on the dorsal side of the abdomen; other Sarcophagids have the black markings divided by a dorsal black stripe, and the black dots, if present, are not distributed in parallel rows on the segments, or they are not as large and clear-cut as those on *W. euvittata*.

Habits.

These flies are very well known to persons who have had occasion to come into the immediate vicinity of brown locust egg nests and hopper bands at times when the flies are present. They are a great nuisance when anybody is walking in the field during the day, since they have a habit of trying to settle on the mouth and face. The flies are very active at high temperatures; in the laboratory the writer observed that flies kept in an incubator at a temperature of 32 to 35° C. were always moving about, flying and making a loud humming noise. Towards the evening they will usually remain quiet, and in the field it was observed that the flies do not attempt to larviposit on locusts at that time.

Scavenger or parasite?

The Sarcophagid flies are known to be scavengers, parasites, or both scavengers and parasites in their larval stages. There appears, however, to be a very interesting transition from the scavenger habit to parasitism (Aldrich 1916).

According to Aldrich (1915) *Sarcophaga sarracenioides* Aldrich has been reported to parasitize grasshoppers and also to breed in dead fish and possibly human excrement; *Sarcophaga helcis* has been reported to breed in cow manure, but will also parasitize adult beetles, grasshoppers, lepidopterous larvae and other insects. These flies are therefore definitely scavengers and parasites. In Amerika

Walker (1920) and Ford (1932, 1936) have found that young animals and human beings (babies) are attacked by *Wohlfahrtia vigil* (Walker) while in parts of Europe, and particularly in Russia, *Wohlfahrtia magnifica* Schiner [= *Sarcophila wohlfahrtia* Portchinsky] has been known for many years as a parasite of man and various domestic animals. *Helicobia australis* prefers decomposed to fresh meat (Fuller 1939) and does not develop in living grasshoppers, although its larvæ will develop in dead grasshoppers. This species can therefore be considered as a scavenger only.

Wohlfahrtia euvittata Vill. has been found to be both a scavenger and a parasite. Its parasitic habit appears to be confined mainly to the brown locust, *Locustana pardalina* (Walker) in its swarm phase, although *Schistocerca gregaria* (Forsk.) and *Nomadacris septemfasciata* (Serv.) have also been reported to be parasitized (Faure 1935). In the role of scavenger it has been observed to visit, and it probably breeds in, animal excrement, and dead locusts; in the laboratory larvæ were readily deposited on fresh raw beef.

No solitary phase locusts have been found parasitized by these flies, possibly owing to the fact that the small numbers of these locusts present prevent the flies from finding them at the critical times. There is every reason to believe that the flies breed normally in carrion, and are mainly attracted to moulting hoppers, freshly laid eggpackages, and vermiform larvæ, by their moist condition and odour. Sick and disabled adult locusts are also attacked but in no instance has it been observed that they are able to parasitize healthy active locusts.

Larvi- and oviposition.

The Sarcophagid flies either larviposit or oviposit on the material or host, which serves as food for their larvæ. According to observations made by Potgieter (1929), by various locust officers in the field, and by the writer in the laboratory, *Wohlfahrtia euvittata* normally larviposits. In the laboratory larvæ were sometimes extruded in the form of eggs or immature larvæ, when the adults were kept in close association with raw beef. Potgieter also found that many larvæ were extruded in an immature state when flies were held captive. According to Ford (1936) this also happens in the case of *Wohlfahrtia vigil* (Walker), and the larvæ later develop normally when kept in fresh, moist raw beef. The eggs extruded in this way by *W. euvittata* did not develop when kept in a moist cut of fresh raw beef by the writer. Only two batches of these eggs were experimented with, and it may be possible that the stimulus of the raw beef, which results in the larvæ being extruded prematurely, may not always be strong enough to cause eggs to be produced in such an immature state that further development is impossible.

Method of attacking the host.

According to observations made by Kelly (1914), Aldrich (1915) and others, the method of attack varies with the different species of flies. For instance in the case of *Sarcophaga kellyi* Aldrich the fly will attack the grasshoppers *Melanoplus differentialis*, *M. bivittatus* and *M. atlantis* in flight, knock them down and deposit its larva at the base of the hind wing; or it will parasitize newly moulted hoppers, which are still soft and are moving about slowly. From observations it was evident that the flies did not distinguish the grasshoppers from other insects in flight and attacked every flying object.

Field observations made by entomologists and locust officers in South Africa have shown that *W. euvittata* attacks its host at various stages in its life cycle. It larviposits on new-laid or partially hatched egg-packages, in which the larvæ then live as egg predators, and crawl from one to the other in their search for food, or the female deposits her larvæ on hoppers which are moulting.

During field operations in the Jacobsdal district in 1935 Mr. D. van V. Webb observed that a number of wasps (fam. Sphegidae) were paralyzing locust hoppers confined in a galvanized iron barrier. As soon as a wasp had paralyzed its victim and was dragging it along to the burrow, one or more flies would try to parasitize the hopper. A fight between the fly and wasp would follow and continue until the wasp had finally buried its victim. Even after the wasp had dragged the hopper into the burrow, the fly would still persist in following. After about nine days the soil of the area in which the hoppers had been buried by the wasps was investigated. Forty hoppers were found, of which only two had wasps larvæ feeding on them. All the other hoppers were occupied by fly larvæ of different sizes, as many as four being found in one hopper.

On this occasion it was observed that, although the flies tried to parasitize healthy active hoppers, they did not succeed, since they were kicked away as soon as they came near, and their wings were so torn and broken after a time that they could no longer fly. Young hoppers, which had died in a barrier and were lying in heaps in a shaded corner soon became infested with numbers of *Wohlfahrtia* larvæ. Isolated locusts dying in the field were not observed to become infested, the probable explanation being that they dried out too soon. Cattle dung and human excrement were also observed to dry out very quickly when exposed, with the result that the *Wohlfahrtia* larvæ which had been deposited therein could not develop; or the excrement was removed by dung beetles before the larvæ could reach maturity. Flasks containing human excrement were placed in the field to see whether the flies would larviposit on it. It was observed that larvæ were deposited, but after a day or two

such a large number of small Coleoptera infested the excrement and it was so dry that the larvæ could not develop further.

In the laboratory gravid flies were kept in cages with healthy active hoppers of *L. pardalina*; the flies did not even make an attempt to larviposit on the hoppers. After one of the females died, it was observed that her larvæ devoured her from the inside and crawled out after about 24 hours, searching for food. When on one occasion a moulting hopper was introduced into a cage in which a female was kept, she soon showed her interest by running round it in circles, giving short little jumps and flying short distances. As soon as the head of the hopper emerged from the exuviae she started running backwards and forwards over it, sucking the wet soft body with her proboscis and holding the abdomen high in the air. Very soon she deposited seven larvæ behind the pronotum. Some of these larvæ disappeared under the pronotum while others entered the body through the stigmata.

Life history.

A number of puparia taken from brown locust egg-nests in the Jacobsdal district, Orange Free State, were sent to Pretoria for laboratory studies. On arrival at Pretoria the puparia were packed in sand in muslin-covered jars, and kept at room temperature. The sand in some of the jars was kept dry and in others moistened. After a few days adult flies began emerging in all the jars, whether they were kept dry or not; this indicates that moisture is not necessary for final development, and confirms the experiments made by Potgieter (1929). Adults also emerged after a few days from puparia kept in muslin-covered jars with no sand to cover them. It was then observed that some of the flies were located wrongly in the puparia, with the result that they were emerging backwards; none of these flies managed to extricate their heads, and consequently they died after a day or two.

The adult flies were kept outside in the open air in calico-covered cages under a calico awning, and fed on a concentrated sugar solution; fresh raw beef was provided every day.

Two days after emergence the flies were already mating and the first larvæ were produced twenty-five days after the adult flies had emerged. The larvæ were fed on fresh raw beef and reached maturity seven days after being deposited on the meat. After crawling about for two days in the moist sand kept at the bottom of the jar, the larvæ pupated at different depths in the sand. Some larvæ were allowed to feed for only three-and-a-half days; these also pupated, but the resulting adults were much smaller than usual. From twenty-five to thirty days after the larvæ had pupated the first adult flies started to emerge, and the females produced the

first larvæ about twenty-one days after emergence. Potgieter found that the duration of the stages was: —

Larva: Feeding period 5—8 days.

Full-grown and not feeding: 6—12 days.

These were results obtained from 258 larvæ.

Puparium: 16—30 days in summer (84 flies).

30—120 days in winter (76 flies).

Longevity: (a) Males 84, 64, 52 days.

(b) Females 80, 71 and 66 days.

The longevity periods above were the three longest periods observed by Potgieter in each case, and three generations were produced in one year. These records agree with the results obtained by the writer during the summer from October to March (1935—36) in Pretoria, but the adult flies did not survive through the winter in Pretoria.

According to Potgieter breeding takes place during the whole year; Smit and du Plessis (1927) recorded adults caught in blow-fly traps at Middelburg, Cape in July, August, September and January, and at Beaufort West, Elliot, Keetmanshoop, and Windhoek during the period August to March. Other observers have also reported that the adults may be found practically throughout the year.

While making observations in the field, Mr. D. van V. Webb squeezed larvæ from the abdomen of a *Wohlfahrtia* female on to locust hoppers that had been killed with boiling water and partially dried. After seven days the larvæ were 7 mm. wide and 23 mm. long and did not feed any more; they pupated soon after. No further observations were made on this aspect by Mr. Webb, but his notes show that there is no doubt that *Wohlfahrtia* will breed in dead hoppers, provided, that they do not dry out too quickly.

Time taken to kill a locust.

While making his observations on *W. euvittata*, Mr. Webb also squeezed larvæ from the abdomen of a female caught in the field on to active healthy hoppers of various stages caught at the same time, one larva on each hopper. The hoppers were held in the observer's hand and the larvæ were squeezed from the abdomen of a female on to the hoppers at a spot behind the pronotum. The larvæ entered the body of the hoppers, showing that even active locusts could be parasitized if it were possible for the female to deposit larvæ on their bodies. The reason why this does not happen under natural conditions can therefore only be the active defensive

reactions of the locusts when the flies attack them. The length of time taken by the larvæ to kill these locusts, the period during which they remained in the host, and the stage of development reached were as follows: —

Number of hoppers	Instar of <i>Locustana pardalina</i>	Time taken to kill locust (hours)	Interval after which larvæ left the host (hours)	Size of Larvæ
2	2nd	20	49	5 mm × 15 mm
1	3rd	17		1 mm × 3 mm
2	5th	20	96	7 mm × 21 mm

The size of the larva in the 3rd stage hopper was noted when the locust died; but the others were measured when they had consumed the internal organs, leaving only the cuticula, and were leaving the hoppers. The length of time taken to kill the locusts did not vary to a great extent. The size of the larvæ appears to increase with the size of the hoppers, i. e. the amount of food available. Further field observations showed that hoppers which had been parasitized when moulting, followed the migrating band at first, but soon lagged behind, and died after a day or two.

It is therefore apparent that the fly larvæ kill their hosts within the very short period of about 20 to 48 hours and that they can be considered as very affective in this respect.

Will a wohlfahrtia fly reared as a scavenger parasitize locusts?

In one experiment the writer was successful in proving that a female fly reared on meat will parasitize a moulting hopper. Adult flies were isolated in pairs in small muslincovered cages, and fed on a concentrated sugar solution. These flies were adults from the second generation reared on meat, i. e. adults emerging from puparia received from Jacobsdal district were allowed to larviposit on meat. The flies reared from the latter were again allowed to larviposit on meat, and a pair of adults resulting from this second brood on meat were used in this experiment. They were kept together in their cage for twenty-five days before a fifth-stage moulting hopper was introduced into the cage. The female very soon showed her interest in the moulting hopper and deposited seven larvæ in quick succession on it.

These larvæ entered the body of the freshly moulted adult,

and were allowed to feed in it; other locusts were killed by removing the heads, and placed with the open wound against a spiracle opening of the partly consumed locust. The larvæ were therefore able to enter directly into the additional locusts provided, and they did so. The larvæ were full-grown after six days, and they all pupated on the eighth and ninth day. The resulting adults, which were typical *Wohlfahrtia* specimens, died before it could be determined whether they would again deposit their larvæ on meat. This shows (1) that adult flies obtained from larvæ reared on locust eggs, readily larviposit on fresh beef, and (2) that in one experiment, a female reared on meat larviposited on a moulting locust.

Although only this one experiment has been made, there seems to be no reason to doubt that individuals of one and the same species and race can live both as scavenger and as parasites, since other flies of the same generation, which were not kept away from meat, readily deposited their larvæ on the meat provided. It therefore seems safe to conclude that *W. euvittata* will in the field either attack living locust, or breed in dead locusts, carrion, meat, locust eggs, and probably other animal matter.

Summary of the life history.

W. euvittata flies larviposits on their host or on the material in which they live as scavengers. At summer temperatures in Pretoria the duration of the larval stage was found to be from eight to nine days; the pupal stage lasted from 25 to 30 days, and the adults larviposited twenty-five days after emergence as adults. Some flies have been kept alive in captivity from fifty-two to eighty-four days by Potgieter (1929) and three generations were bred in one year.

Economic importance and possible artificial breeding.

According to Kelly (1914) the parasitic fly *Sarcophaga kellyi* Aldrich exercises a fairly strong controlling influence on the grasshopper, *Melanoplus differentialis* in the prairie regions of the western states in the United States of America. *Wohlfahrtia euvittata* does not exercise noticeable control on the brown locust, since large numbers of swarms of locusts have repeatedly resulted from the increase of a very small number of solitary phase individuals. Although the *W. euvittata* flies are almost always present in the vicinity of locust swarms, they do not seem to breed in proportion to the increase of the locusts, and large numbers of the fly are usually only observed after the swarm cycle of the locusts has reached a maximum. Even then only isolated bands of hoppers of the brown locust are destroyed by *W. euvittata*.

Since it has often been suggested that this fly should be reared

artificially and released in the immediate vicinity of the locust swarms, the question naturally arises whether this method of locust destruction is practicable, and whether the artificially reared flies would be effective in destroying and controlling the locusts. The practicability of this method of locust control is apparently dependent on many factors in the life history and habits of the fly over which no control can be exercised.

When all that is known about the life history and habits of the fly is considered, it is evident that the following factors will govern its efficiency as a parasite in the field, and its artificial rearing and use: —

(I) The flies will attack the locust only under certain circumstances i. e. when the eggs are newly laid, and are not yet covered with sand, when they are partly exposed by rodents or other predators, or when they are starting to hatch; when the hoppers are moulting or when they are already sick or wounded; only the phases *transiens congregans* and *gregaria* are attacked, not *solitaria*.

(II) There is an interval of fifty to sixty days from the time the larvæ have been produced, until the resulting adults are ready to larviposit again, while the phase *solitaria* of *L. pardalina* produces one generation every forty-five to fifty days. The flies are therefore not able to multiply at a greater rate than the locust.

(III) Since the flies only parasitize the locust at certain critical times, it follows that the flies will quite often not be ready for larviposition at these times; and since it has been proved that they are not dependent on the locusts for a medium in which to rear their young, they may utilize other media for larviposition, which may often result in the death of the larvæ due to lack of sufficient food, exposure, or too rapid desiccation.

(IV) It is not clear whether this is due to the lack of continuous observations, or whether it is an actual fact, but the abundance of *W. euvittata* appears to be closely associated with the abundance of *L. pardalina* in the phases *transiens congregans* or *gregaria*.

The flies have sometimes been observed on carrion, but as a general rule they do not appear to attract much attention at times when locust swarms are absent. Smit and du Plessis (1927) recorded that from 1 % to 12 % of the flies caught in blow-fly traps in various localities from July 1924 to July 1925 were *W. euvittata*. The highest percentage caught was 12 % in the Beaufort West district during March 1925, but it should be noted that there was a heavy brown locust outbreak in the Cape Province during the season 1924—25. It may therefore be that *W. euvittata* does not breed rapidly in carrion under natural conditions, possibly owing to the presence and competition of other flies, with the result that it is not generally observed in large numbers. Only when swarms of

locusts are present, and a maximum amount of locust breeding material is available, do the flies appear to concentrate on the locusts and to increase until large numbers can be observed. If these assumptions are correct, it would seem to be doubtful whether the fly could be reared in large numbers through many generations on meat, since it appears to be closely associated in some way with the presence of large numbers of locusts in the field.

(V) When rearing the flies in the laboratory, it was found that although they readily deposited their larvæ on the raw beef, their numbers did not increase, and they later died out. Observations showed that the stimulus of the raw beef sometimes resulted in larvæ being extruded in a premature condition; these larvæ did not develop further. Many larvæ did not attain maturity and in one case it was observed that an older and bigger larva devoured a very small one. Very detailed and careful research will therefore have to be carried out, before a satisfactory technique can be developed for the artificial rearing of these flies on a large scale.

Although the parasite kills the locusts when it gets a chance to attack, it is evident that it is greatly handicapped by limiting factors in its own life history and habits, and these would always be a great hindrance in any attempt to control locust swarms by making artificial use of this fly.

This method of locust destruction would therefore not offer a solution of the problem of the control of the large numbers of locust swarms present during an invasion, and compared with modern methods of destruction it can be considered as unprofitable and impracticable.

The writer has therefore come to the following conclusions on the status and possible artificial utilization of *Wohlfahrtia euvittata*: —

(a) There are no reliable records of any largescale destruction of hopper bands of *L. pardalina* by the fly. It is, therefore, doubtful whether the fly would be able to exert any marked controlling influence on the numbers of the locust, even if its numbers were re-inforced by mass-breeding and liberation.

(b) The fly is only able to attack the locust at certain critical periods in the development of the latter, therefore continuous and extensive mass-breeding and liberation would at best only result in partial control.

(c) There is no evidence that the fly ever attacks phase *solitaria* of *L. pardalina* in nature; it is, therefore, obvious that mass-breeding would not result in reduction of the numbers of the phase *solitaria*; this is a very serious limitation, since it would be most desirable to have a natural enemy that could reduce the numbers of the phase

solitaria before a density high enough for incipient swarming is attained.

(d) Although the fly has been reared in meat, and probably breeds in carrion in nature, it would probably not prove to be an easy matter to rear it on a large scale in the laboratory.

Summary.

The natural habitat of the locust fly, *Wohlfahrtia euvittata* Vill. coincides with that of the brown locust, *Locustana pardalina* (Walker). This fly has been proved to be both a scavenger and a parasite. The females usually larviposit, and it takes fifty to sixty days from the time larvæ are deposited for the resulting flies to reach the larvipositing stage. Although the flies are able to kill locusts quickly and effectively, they are handicapped by their inability to parasitize locusts in all stages of development. These flies are therefore only beneficial to a very limited extent. There is no evidence that it would be worth while to undertake mass-breeding and liberation, since general observations have shown that this fly cannot control incipient swarming of the brown locust, nor is it able to destroy swarms already formed to any great extent, even when it is present in large numbers.

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Phlaeothripidae (Thysanoptera) new to South Africa, with descriptions of new genera and species

by

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Podothrips graminum Priesner.

1937 *Podothrips longiceps* Jacot-Guillarmod (in. part).

On receiving Priesner's description, I restudied my specimens of *P. longiceps* m. and found one macropterous male to belong to *graminum*. Comparison with two of Dr. Priesner's paratypes, which he was kind enough to send me, proves it without doubt to be *graminum*. This specimen was taken at Potgietersrust, Transvaal, 29-V-1933, on grass (*J. C. Faure*).

Karnyothrips melaleucus (Bagnall).

I have two macropterous female specimens of *Karnyothrips* before me which most probably belong to this species. These were collected at Port St. Johns, Pondoland, Cape Province, on 19-IV-1935, among dry leaves (*C. Jacot-Guillarmod*).

Liothrips gymnosporiæ Priesner.

I sent Dr. Priesner some specimens of a *Liothrips* to compare with this *gymnosporiæ*, as I thought them to be either identical with, or very close to this species. I must thank Dr. Priesner for having compared them with his specimens; he states: „Your specimens are somewhat larger, fore femora somewhat stouter, double fringe somewhat richer. But these are only relative differences". I possess a number of specimens of this species, collected as follows:

Cape Province: Fort Cox Agricultural School, Kingwilliamstown, foliage of *Gymnosporia* sp. (probably *numarosa* Syzsz.); (det. Miss I. C. Verdoorn), on 29-III-1938 (*C. Jacot-Guillarmod*).

Transvaal: Pretoria, foliage of *Gymnosporia buxifolia* Szysz., (det. Miss I. C. Verdoorn), on 7-XII-1938 (*Miss A. F. Hean*).

This is a very common species on *Gymnosporia buxifolia* in Pretoria.

Cercothrips after Priesner.

I have 22 specimens (males and females) before me which belong to this species. Five of the specimens Dr. Priesner was kind enough to determine for Prof. Faure. These specimens were collected at Durban, Natal, in curled leaves of *Ficus natalensis*, on 5-IX-1922 (J. C. Faure).

At Escombe, near Durban, Natal, the writer collected on *Ficus Petersii* Warb. numerous larvæ, pupæ and a few adults, (April 8th., 1939). The larvæ were generally found grouped together in large numbers, forming conspicuous bright red colonies on the surface of the leaves. The curling of some leaves, in which a few larvæ were found, was probably due to a species of *Gynaikothrips* which was found in great numbers in such curled leaves.

This species may prove to be the same as *Gigantothrips turneri* Bagnall from Port St. Johns, Cape Province; if it does prove to be the same after authentic material or the types have been compared, then Bagnall's species will fall into synonymy.

ZULUIELLA gen. nov.

Body not reticulate. Head about one-and-a-half times as long as wide, somewhat produced between the two basal antennal segments. Vertex not protruding and the median ocellus not overhanging, cheek spines and warts absent. Eyes small, distinctly bulging, not produced ventrally, the head distinctly constricted at the hind angles of the eyes. Ocelli forming an obtuse angled isosceles triangle. Postocular setæ distinct, shorter than the eye, rather widely separated, expanded at the tip. Mouth cone short and rounded, reaching about the middle of the prosternum. Antennæ rather heavy, eight-segmented, VIII not pedicellate; all sense cones moderately long. Prothorax about three-quarters the length of the head and less than twice as wide (including the coxæ) as long; anterior margin not thickened; epimera not fused with the pronotum; all setæ present, expanded at the tips. Legs rather short, fore femora and tibiæ normal, unarmed; fore tarsi with a distinct tooth near the base. Wings broadest near the base, not constricted at the middle. Abdomen broadest at about segment V; tube shorter than the head, more or less conical, without long clothing hairs, its terminal setæ short.

Genotype: *Zuluella distincta* sp. n.

This genus, as pointed out by Dr. Priesner, resembles in general appearance *Hoplothrips* (*Trichothrips*) from which it may be separated by the shape of the setæ, and the strongly constricted head behind the eyes, the latter character reminding one of some Glypto-

thripini, e.g. *Sagenothrips* Pr., from which it may be separated by the broader antennæ, the shorter sense cones and the eighth antennal segment not being pedicellate. „*Cryptothrips*” fuscicauda Trybom seems to be closely related to the present form, but may be separated by the reticulations, the narrower antennæ and the prothoracic setæ being knobbed and not expanded. *Trichothrips natalensis* Trybom may easily be separated by the shape of the head, the unarmed fore tarsi, and the pointed prothoracic setæ, while *Trichothrips transvaalensis* Hood also differs in the shape of the head, the narrower antennæ and the pointed setæ.

Zuluella distincta sp. n. (Fig. 1, 2).

Female (macropterous). ... Length about 2 mm. General colour brownish yellow. Head uniformly brownish yellow, slightly darker between the eyes and the antennæ. Antennal segments I and II paler and more yellow than the head; III brownish yellow, paler on the pedicel; IV and VIII yellowish brown, gradually becoming darker towards the apex of the antenna, VIII the darkest. Prothorax brownish yellow, the same shade as the head, pterothorax brownish yellow, shaded with darker brown at the sides. Abdomen pale brownish yellow at the base, gradually becoming darker and more brown caudad, so that segments VII to IX are distinctly brown; tube, dark brown in the middle, yellowish brown at the base and paler brown at the apex. All legs yellow, the femora slightly shaded with pale brown on the outer margins. Wings hyaline except the extreme bases of the fore pair which are shaded with brown. All setæ pale yellow except those on the ninth abdominal segment which are shaded with brown at the base, and the terminals which are completely shaded with brown. Mesodermal pigmentation very scant, where present red.

Head distinctly longer than wide, 1.5 times as long as width at eyes, which is about the same as the greatest width across the cheeks. Cheeks evenly rounded from the eyes to the base of the head, distinctly narrower at the hind angle of the eyes which is 0.84 the greatest width. Surface of head smooth, not reticulate. Cheek spines absent. Eyes small, about 0.3 the length of the head, distinctly bulging, in the holotype the measurements in μ as follows: length 61, width 38—41, interval 61. Post-ocellar setæ minute; post-ocular setæ well developed, expanded at the tip, in the holotype 49 μ long, 102 μ apart and 23 μ from the hind margin of the eye; dorsocephalic setæ minute, nearer together and slightly caudad to the post-ocular setæ. Posterior pair of ocelli about 33 μ apart and their fore margin in a line which would mark off about the anterior fifth of the eyes; median ocellus on a very slight prominence thus directed more or

less forward, about $21\ \mu$ from the posterior ocelli. *Antenna* about 1.7 times as long as the head; segment III asymmetrical, with a bent pedicel, about 1.66 times as long as wide, slightly shorter than IV which is 1.62 times as long as wide, and the longest segment of the antenna; segment VIII broadest at base, thus more or less broadly joined to VII; shapes and chaetotaxy of segments as in figure. Sense cones distributed on inner (outer) surfaces as follows: III 1 (1), IV 2 (2), V 1 ($1 + 1$), VI 1 ($1 + 1$), VII one on dorsum; in the right antenna of the holotype they are III 1 (2), otherwise normal. Sense area on segment II within the apical half of the segment. Mouth cone short, broadly rounded, just about reaching the middle of the prosternum.

Prothorax shorter than the head, along the median line of the pronotum about 0.74 the length of the head and, including the coxae, about 1.83 times as long as wide. Surface smooth; median thickening absent; epimera not fused with the pronotum. Usual setae present, expanded at the tip, in the holotype measuring as follows in μ : antero-marginal 37, antero-angular 32, mid-lateral 45, epimeral 57—63, postero-marginal 53, coxal 41. Pterothorax wider than the prothorax, slightly narrowed posteriorly; mesonotum with indistinct reticulations anteriorly. *Wings* not narrowed in the middle, fore wings about 13 times as long as width at middle; duplicated cilia on its hind margin absent. Subbasal setae on the fore wing expanded at the tip, more or less forming a right-angled triangle, their measurements in the holotype in μ as follows: a) 25, b) 22, c) 29. Fore legs rather short, slightly enlarged, femora and tibiae unarmed, tarsus with a large curved tooth, slightly shorter than the width of the tarsus; middle and hind legs normal, rather short.

Abdomen broadest at segment V where it is broader than the pterothorax, thence gradually narrowing to the tube. Wing-retaining setae represented by a pair of straight setae, expanded at the tip and about $45\ \mu$ long. Pores on terga I-IV in the holotype 71, 45, 32, $40\ \mu$ apart respectively. Tube short and conical, about 0.63 the length of the head and 1.68 times as long as its own greatest subbasal width which is about twice its least apical width. All major setae on segments II-VI expanded at the tip; those on VII expanded at the tip except the external lateral pair which are pointed; the dorsal setae on VIII expanded at the tip while the lateral pairs, those on IX and the terminal are pointed. Longest seta on segment IX shorter than tube, 100—100 μ long. Longest terminal seta 82—97 μ long.

Measurements of female (holotype) in mm. ... Length (distended) 2.30; head, median dorsal length 0.212, width across eyes 0.141, least width at hind angles of eyes 0.118, greatest width across cheeks 0.141; prothorax, median length of pronotum 0.156, width (including coxae) 0.284; pterothorax, greatest width 0.307; abdomen, greatest

width (segment V) 0.322; tube, length 0.133, greatest subbasal width 0.079, least apical width 0.037.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	32	40	53	55	51	50	45	29
Widths in μ	40	37	32	34	29	26	24	13

Total length of antenna 0.355 mm.

Described from three macropterous females, collected at Hluhluwe, Zululand, two in „grass sweepings” on 2-III-1937 (*C. Jacot-Guillarmod*) and one in „grass sweepings mostly *Themeda triandra*” on 22-II-1937 (*C. Jacot-Guillarmod*).

The affinities of this species are discussed under the genus.

AGROTHRIPS gen. nov.

Head narrow, more than 1.5 times as long as broad, smooth; cheeks subparallel, with no spines; vertex not elevated or overhanging; ocelli absent; post-ocular setæ pointed, placed close to the hind margins of the eyes and cheeks. Antennæ eight-segmented, broad, segment III with a shelf-like ringlet near the base, VII the longest segment; VIII broadest at the base thus rather closely connected with VII; sense cones small and difficult to see; sense area on II near the apex. Mouth cone broadly rounded, attaining about the middle of the prosternum. Prothorax not transverse, including the coxæ about one-and-a-half times as wide as long and not quite three-quarters the length of the head; median dorsal thickening absent; antero-marginal, mid-lateral and coxal setæ vestigial, antero-angular setæ very short, weak and pointed; epimeral and postero-marginal setæ normal, pointed. Suture between the meso- and metanotum absent. Wings absent. Fore legs short, slightly enlarged; fore tarsus with a forwardly directed, curved tooth (as in *Karnyothrips*) in both sexes; middle and hind legs short. Abdomen long; tube short, about half the length of the head.

Genotype: *Agrothrips priesneri* sp. n.

Although the specimens are apterous, there is little doubt that this form belongs to the Haplothripini, closely allied to *Apterygothrips* Pr., *Cephalothrips* Uzel and *Bagnalliella* Karny; from all three it may be separated by the shape of the third antennal segment, the *Karnyothrips*-like tooth on the fore tarsus, the fused condition of the metathorax, and the seventh antennal segment being the longest of the segments. In the arrangement of the sense cones it appears to come nearest to *Cephalothrips*. The tooth of the fore tarsus suggests *Karnyothrips* Watson, but from this genus the

present one differs in the shorter anal setæ, the shape of the third antennal segment and the absence of wings. The shelf-like ringlet near the base of the third antennal segment allows comparison with *Hadothrips* Pr. and *Priesneria* Bagn.; it differs, however, according to Dr. Priesner, who was kind enough to examine this form, from the latter in not having enlarged fore and hind femora, and from the former in that form having long, slender antennæ and legs, transverse pterothorax, no tarsal tooth and knobbed bristles.

***Agrothrips priesneri* sp. n.** (Fig. 3, 4).

Female (Apterous). Length about 2 mm. General colour yellow except for the following: antennal segment IV slightly darker; V brownish yellow, tinged with brown at the apex and the lateral margins; VI yellowish brown, paler near the base, the extreme base having a brown ring; VII and VIII brown. Tube brown with the extreme base abruptly yellow. Each tarsus with a black spot and the extreme apices of the maxillæ black. All setæ hyaline. Mesodermal pigmentation absent.

Head much longer than wide, 1.79 times as long as the width across the eyes and 1.73 that at the greatest width across the cheeks; smooth; vertex not elevated nor overhanging; cheeks subparallel, slightly converging to the base of the head where the width is 0.88 the greatest width across the cheeks; a narrow but distinct sub-basal thickening present. Eyes evenly curved with the cheeks, rather flat, about 0.3 the length of the head, their measurements in μ as follows: lengths 59, width 26, interval about 63. Ocelli absent. Post-ocular setæ pointed, 40 μ long. 95 μ apart and 11 μ from the posterior margin of the eyes, rather close to the lateral margin of the head. No other conspicuous setæ on the head. *Antennæ* 1.50 times as long as the head, broad; segment II longer than III which is asymmetrical and with a shelf-like ringlet near the base, 1.44 times as long as wide, subequal to VI and longer than VIII but shorter than IV and V which are subequal, and VII which is the longest of all segments; IV 1.54 times as long as wide, V 1.64 and VII 2.30 times as long as wide; sense cones small and difficult to see, distributed on the inner (outer) surfaces as follows: III 0 (1), IV 1 (1), V 1 (1), VI 1 (0 + 1), VII one on the dorsum. Mouth cone short and broadly rounded, reaching about the middle of the prosternum.

Prothorax along the median line of the pronotum about 0.71 the length of the head and, including the coxæ, 1.54 times as wide as long; surface of the pronotum smooth; median thickening absent; epimera not fused with the pronotum. Setæ greatly reduced, the antero-marginals, mid-laterals and coxals vestigial, the antero-marginals 13 μ long, pointed, the epimerals 47 μ and the postero-marginals about 26 μ , both pointed. Pterothorax narrower than the pro-

thorax (including the coxæ); the suture between the meso- and metanota obsolete; wings absent. Legs short, fore legs slightly thicker than the middle and hind pairs; fore tarsus armed with a forwardly directed curved tooth similar to that in *Karnyothrips*.

Abdomen long and narrow, widest at about segment IV where it is distinctly broader than the pterothorax as well as the prothorax. Distances apart of the pores on terga I to IV in μ as follows: 63, 18, 18, 20 respectively. Tube short and stout, 0.52 the length of the head and 1.91 times as long as the greatest subbasal width which is 1.83 times the least width at the apex; the sides more or less straight, clothing hairs absent. Longest setæ on segment IX 164 μ long, longer than the tube or the terminal setæ which are 143 μ long and thus also longer than the tube. All abdominal setæ pointed, those on segments II—VII rather inconspicuous.

Measurements of female (holotype) in mm. ... Length (distended) 2.06; head, median dorsal length 0.202, width across eyes 0.113, greatest width across cheeks 0.117, least width at base 0.103; prothorax, median length of the pronotum 0.143, width (including the coxæ) 0.220; pterothorax, greatest width 0.171; abdomen, greatest width (segment IV) 0.241; tube, dorsal length 0.105, greatest subbasal width 0.055 (least apical width 0.030).

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	32*	42	36	40	41	36	46	29
Widths in μ	33	31	25	26	25	22	20	11

Total lengths of antenna 0.302 mm.

* This is the total length of the segment, the length of the segment visible outside its socket in the head being only 21 μ .

Male (Apterous). Length about 1.2 mm. In colour as well as in structure the male is identical with the female except for the generally smaller size, thus the description of the female will also hold for the male. Unfortunately both males in hand have been slightly pressed out of shape so that the widths of the head, prothorax, pterothorax and abdomen are not true.

Measurements of allotype (male) in mm. ... Length (distended) 1.36; head, median dorsal length 0.148, width across eyes 0.094, greatest width across cheeks 0.103; eye, length 0.045, width 0.022, interval 0.049; post-ocular setæ, length 0.026, distance apart 0.084, distance from posterior margin of eye 0.008; prothorax, median length of pronotum 0.116, width (including coxæ) 0.166; pterothorax, greatest width 0.169; abdomen, greatest width (segment V) 0.182; tube, dorsal length at least 0.079, greatest subbasal width 0.042, least apical width 0.024; longest seta on abdominal segment IX, length 0.136; longest terminal seta, length 0.118; pores on terga

I—IV, distances apart 0.043, 0.016, 0.011, and 0.013 respectively.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	26	37	28	32	32	29	40	29
Widths in μ	28	25	18	21	21	20	16	9

Total length of antenna 0.248 mm.

Described from three specimens, one female and two males, all apterous, collected at Hluhluwe, Zululand, as follows: 2 males on the grass *Themeda triandra* Forsk on 24-I-1937 (C. Jacot-Guillarmod); 1 female from grass sweepings on 22-II-1937 (C. Jacot-Guillarmod). The affinities of this form have been discussed under the genus.

I take pleasure in dedicating this interesting new form to Dr. Priesner of Cairo, Egypt.

***Dichæothrips xosa* sp. n. (Fig. 5, 6).**

Female (Macropterous). Lengths about 3.5 mm. General colour dark brown. Head very dark brown, slightly paler at the base. Antennal segment I dark brown, paler than the head; II dark brown, paler at the apex; III yellow for the basal half, apical half shaded with brown which becomes darker apically; IV brown, extreme base yellowish and the rest of the basal half slightly paler than the apical half; V—VIII dark brown, stalk of V paler, VII and VIII slightly paler than V and VI. Prothorax and pterothorax dark brown tinged with yellow, distinctly paler than the head. Abdominal segment II brown tinged with yellow, darker at the sides, the abdomen thence gradually becoming darker to the tube, which is almost black, and darker than the head; segments II—V darker along the sides. All femora and middle and hind tibiæ dark brown, paler than the head; fore tibiæ yellowish brown, paler along the inner margin, the pale portion becoming wider at the base and at the apex; fore tarsi yellow, slightly tinged with brown on the outer margin; middle and hind tarsi dark greyish brown. Wings completely hyaline. Cheek spines dark brown; all other spines and setæ of a pale brownish yellow, the terminals being brown at the base. Mesodermal pigmentation bright red.

Head longer than wide, 1.31 times as long as the greatest width across the cheeks; vertex not produced; cheeks subparallel, slightly converging near the base to form a basal collar; dorsal and lateral surfaces with indistinct cross lines, thus giving a slightly roughened appearance to the cheeks, which are set with about six small pointed spines, about 13 μ long. Post-ocular setæ long, blunt, 169 μ long, 164 μ apart and about 15 μ from the posterior margin of the eye; post-ocular setæ about 1.5 the length of the post-ocellars which are also blunt, 107 μ long, 51 μ apart and about 20 μ from the posterior

margin of the posterior ocelli; dorsocephalic setæ rather weak and pointed, $36\ \mu$ long, $102\ \mu$ apart and about $87\ \mu$ from the eye. Eyes about 0.3 the length of the head, somewhat flattened laterally, the postero-angular ommatidia larger than the rest, measurements of eyes in μ as follows: length 92, width about 56, interval about 102; anterior margin of the posterior pair of ocelli placed in a line which would mark off about the anterior quarter of the eyes. $77\ \mu$ apart, $38\ \mu$ from the median ocellus and about $15\ \mu$ in diameter. *Antennæ* stout, about 1.8 times as long as head; segment III 2.97 times as long as wide and 1.43 times as long as IV; IV 2.03 times as long as wide and 1.05 times as long as V; from III gradually becoming shorter until VIII which is the shortest of the segments; shape and chætotaxy of segments as in figure; sense cones short (the outer on III $21\ \mu$ long), distributed on the inner (outer) surfaces as follows: III 0 (1) plus 1 ventrally, IV 1 (1) plus 1 ventrally, V 1 (1 + 1), VI 1 (0 + 1), VII one on dorsum. Mouth cone broadly rounded, reach about the middle of the prosternum.

Prothorax along the median line of the pronotum 0.67 the length of the head, and, including the coxæ, 2.20 times as wide as long smooth; the usual setæ present, long and rather blunt, except the antero-marginals which are vestigial, and the coxals which are represented by two thinner and one thicker spine $23\ \mu$ and $13\ \mu$ long respectively; two setæ present on the epimeron, the usual long one and a shorter pointed seta $33\ \mu$ long; measurements in μ of the other setæ as follows: antero-angular 72, mid-lateral 174, epimeral 174, postero-marginal 154. *Pterothorax* wider than the *prothorax* (including the coxæ), sides converging posteriorly; frontal half of the mesoscutum cross-wrinkled, otherwise like the metascutum, almost smooth. Fore wing about 13 times as long as width at the middle, slightly expanded apically, with 15—16 duplicated cilia on the hind margin. Two conspicuous, blunt, subbasal setæ present with a third short pointed one between them, their measurements in μ as follows: a) 97, b) 16, c) 102, their distances apart a-b $24\ \mu$, b-c $17\ \mu$, Fore legs moderately enlarged, the fore femur $300\ \mu$ long and $136\ \mu$ wide, fore tibiæ $211\ \mu$ long and $62\ \mu$ wide, fore tarsus with conspicuous beak-like tooth, slightly shorter than the width of the tarsus; fore femur with short stout spines on its hind outer angle and a long thin seta about in the middle of its outer margin. Middle and hind legs normal.

Abdomen slightly wider than the *pterothorax*, widest at segments IV and V, sides subparallel from II-V, then converging to the tube; tergum I slightly net-like; the distances of the pores on terga I—IV in μ as follows: 38, 33, 44, 54, respectively. Tube more strongly narrowed at about the apical sixth and conspicuously constricted at the apex, about 1.14 times as long as the head and about

2.9 times as long as width at the base which is nearly three times that at the apex. Longest setæ on segment IX shorter than the tube, $300\ \mu$ long and the terminals shorter than these, $233\ \mu$ long.

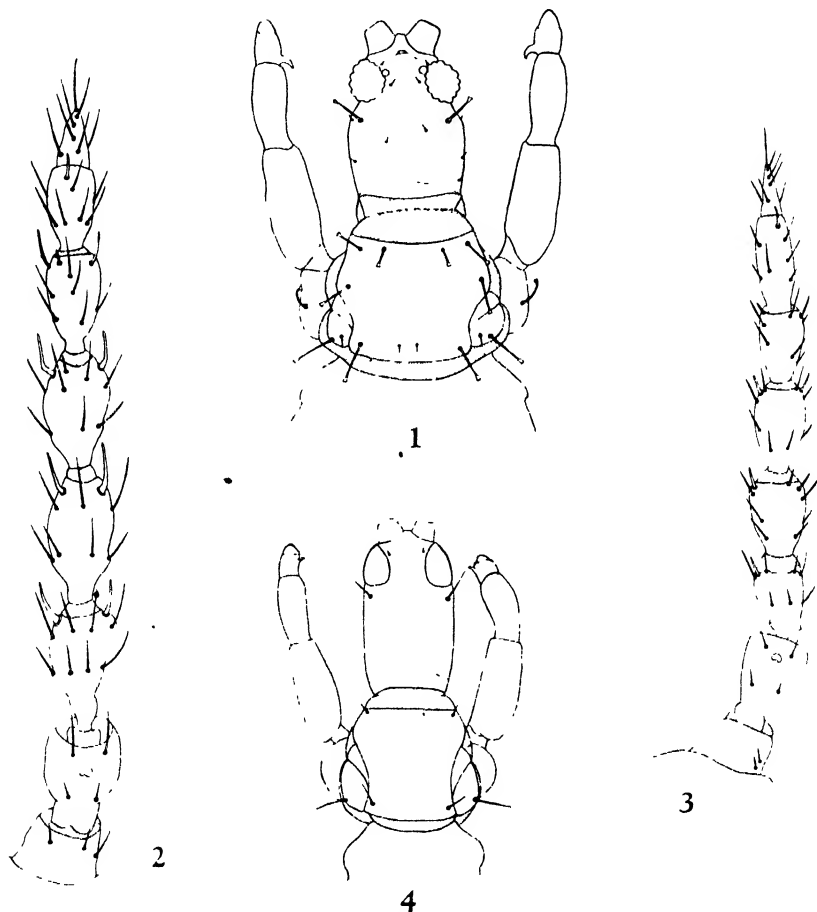


Fig. 1. *Zuhuiella distincta* sp. n., head and prothorax of female paratype.

Fig. 2. *Zuhuiella distincta* sp. n., left antenna of female holotype.

Fig. 3. *Agrothrips priesneri* sp. n., left antenna of female holotype.

Fig. 4. *Agrothrips priesneri* sp. n., head and prothorax of female holotype.

Measurements of holotype (female) in mm. Length (distended) 3.67; head, median dorsal length 0.311, width across eyes 0.225, greatest width across cheeks 0.237, width across basal collar 0.228, width at base of antenna 0.112; length of inter-antennal process

0.028; prothorax, median length of pronotum 0.207, width (including coxæ) 0.455; pterothorax, greatest width 0.522; abdomen, greatest width (segments IV and V) 0.544; forewing, length 1.284, width at middle 0.102; tube, length 0.356, greatest subbasal width 0.123, least apical width 0.054.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	51	70	113	79	75	71	55	47
Width in μ	50	43	38	39	37	34	26	15

Total length of antenna 0.561 mm.

Described from one macropterous female collected at the „Manor House”, Fort Beaufort, Cape Province, in dry pods of *Cassia lævigata* L. on 30-III-1938 (*C. Jacot-Guillarmod*). This species seems to be rather rare; a thorough search was made but no other specimens could be found.

The present species differs from *D. brevicollis* Hood, the genotype, in that *brevicollis* has the fore margin of the pronotum thickened, rudimentary antero-angular setæ and the antennal segment IV longer than III; *D. beesoni* Moulton differs in the paler fore tibiæ, the slightly shaded wings and the head being 1.5 times as long as broad. *D. williamsi* Karny has strong cheek spines and 40 duplicated cilia on the fore wing. *D. penicillatus* Priesner has strong cheek spines and pedicels of antennal joints 6 and 7 broader. I am greatly indebted to Dr. Priesner for examining this species for me and giving me the above comparisons. He further compared it with a new undescribed species of his from the Congo, which differs in the yellow-brown fourth antennal segment, longer and more slender head, somewhat narrowed towards the base, and more conical tube, which is less strongly constricted apically.

Elaphrothrips édouardi sp. n. (Fig. 7, 8).

Male (brachypterous). ... Length about 5. Omm. distended. General colour very dark brown to black. Head uniformly dark brown to black. Antennal segment I dark brown, a shade paler than the head; II dark brown, paler at apex and outer margin; III yellow, shaded with brown for about the apical fifth; IV brown, paler for the median third, this median portion sometimes of a distinctly yellowish tinge; V—VIII dark brown, the same colour as the head. Prothorax dark brown to black. Pterothorax dark brown to black except the membranous parts which are reddish brown. Abdomen dark brown. Fore coxæ and femora dark brown, paler than the head; all trochanters greyish yellow; fore tibiæ dark yellowish brown, paler at the extreme base; fore tarsi brownish yellow; middle and hind femora dark brown; tibiæ dark brown with the extreme bases

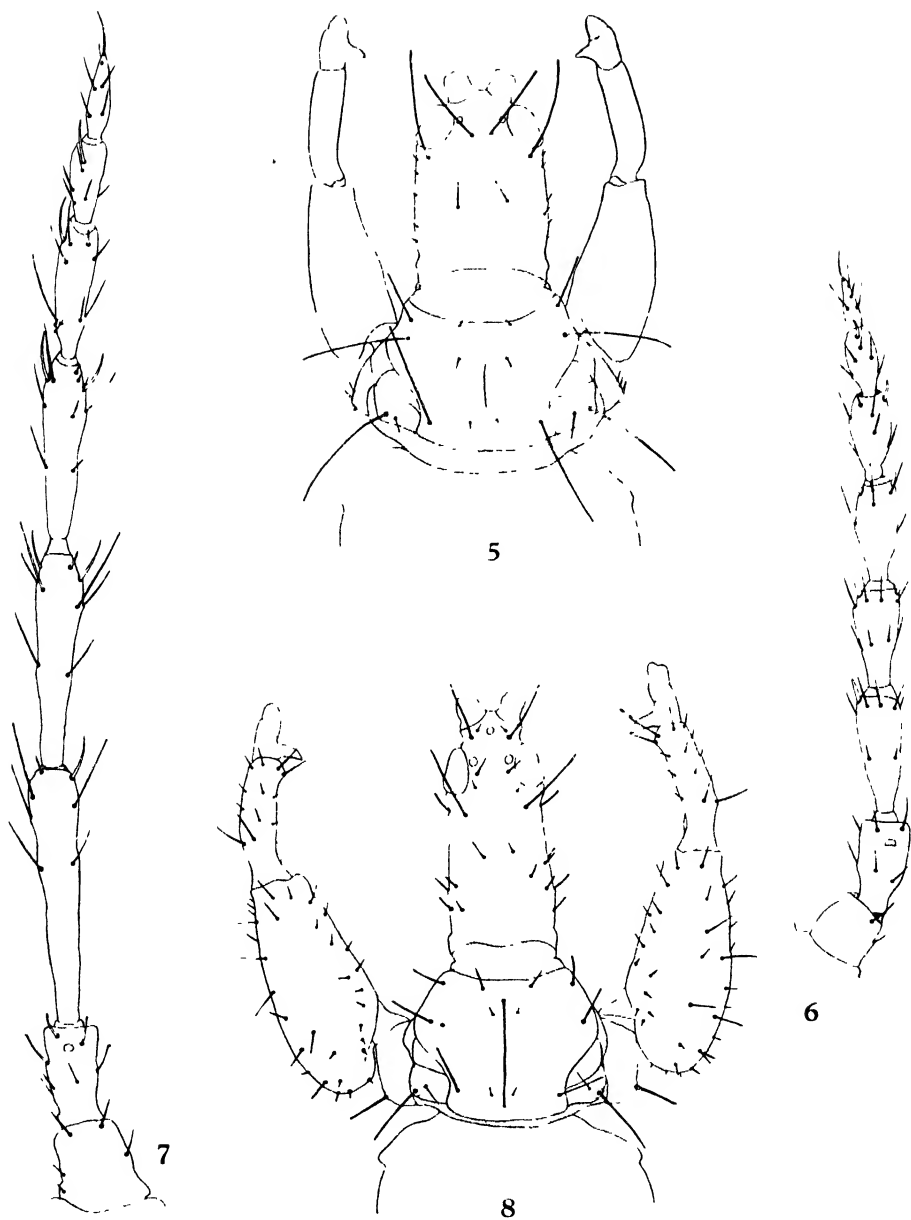


Fig. 5. *Dichætothrips rosa* sp. n., head and prothorax of female holotype.

Fig. 6. *Dichætothrips rosa* sp. n., left antenna of female holotype.

Fig. 7. *Elaphrothrips edouardi* sp. n., right antenna of male paratype.

Fig. 8. *Elaphrothrips edouardi* sp. n., head and prothorax of male paratype.

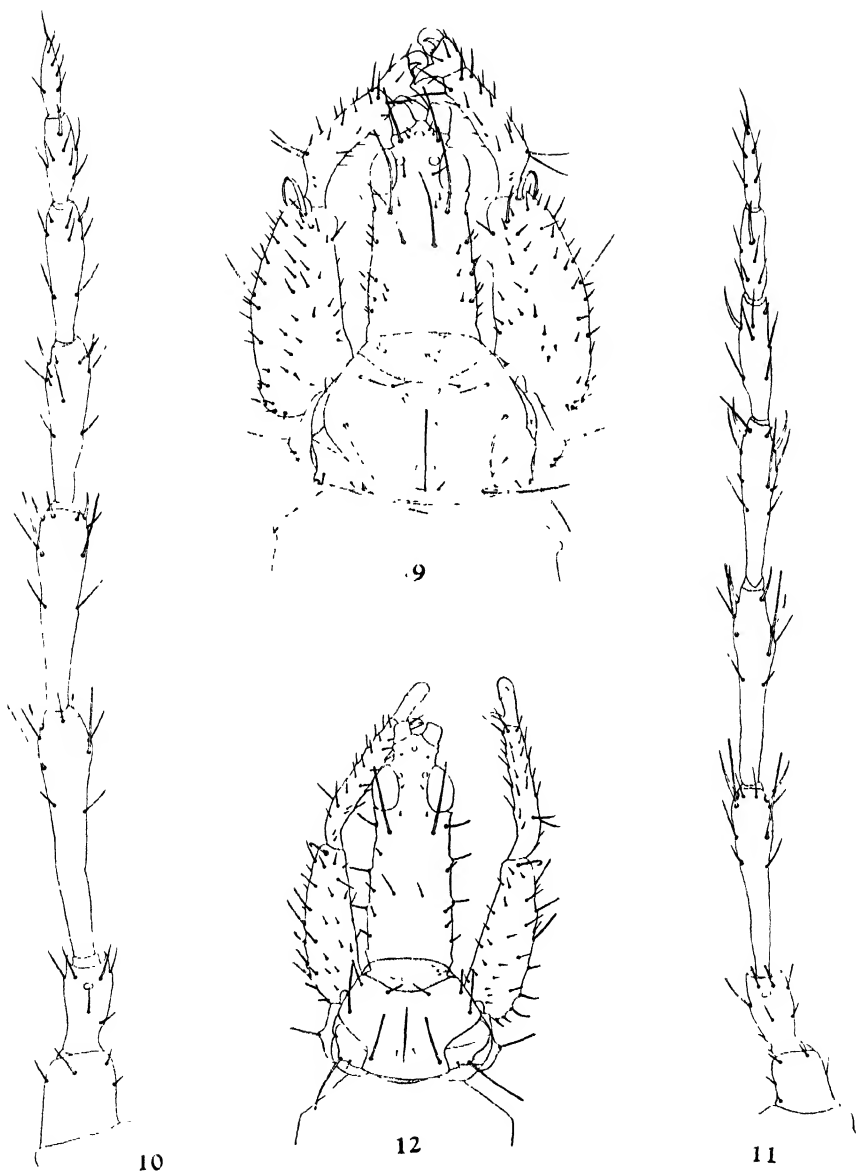


Fig. 9. *Elaphrothrips niger* sp. n., head and prothorax of male paratype.

Fig. 10. *Elaphrothrips niger* sp. n., left antenna of male paratype.

Fig. 11. *Elaphrothrips transvaalensis* sp. n., right antenna of male holotype.

Fig. 12. *Elaphrothrips transvaalensis* sp. n., head and prothorax of male holotype.

paler; tarsi greyish brown. Head and prothoracic setæ tinged with brown; abdominal setæ, (excepting the terminals which are dark brown at the base) tinged with yellow. Mesodermal pigment present, bright red.

Head 2.15—2.35 times as long as width at the eyes and 2.0—2.2 times as long as the greatest width across the cheeks, which is near the base; weakly produced beyond the eyes, the process about 0.28—0.33 as long as the greatest width of the head across the cheeks, about 1.64—1.96 as wide at base as its own median length and 1.70—2.03 times as wide at the base of the antennæ as its own median length, nearly as broad at the base as at the base of the antennæ, sides concave. Cheeks not subparallel, fairly straight diverging from shortly behind the eyes (at the origin of the first cheek spines) to near the bases, flaring as usual to the eyes, forming short but usually distinct tempora; the length of the cheek about 1.60—1.65 the least width of the head, set with about four or five slightly knobbed major setæ, the anterior pair the longest, 38—51 μ long. Ante-ocular setæ about 130 μ long, similar to the post-oculars. Post-oculars pointed, placed about in a line which would mark off the middle of the eye, about 36—51 μ long, i. e. about equal to the dorsocephalics (33—49 μ) which are placed about 143 μ from the eye and 72 μ apart. Post-oculars slightly broadened at the tip, about 140 μ long, 138 μ apart and about 36 μ from the posterior margin of the eyes. Eyes prominent, rather flattened, with a slight notch near the posterior external angle, only 0.22 the length of the head; those of one of the paratypes measuring as follows: lengths 123 μ , width 69 μ , interval 107 μ . Ocelli of the posterior pair with their fore margins in a line which would mark off about the anterior quarter of the eyes, their diameter 21 μ , interval 69 μ and distance from the median ocellus 61 μ . *Antenna* slender, about 1.6 times as long as the head, segments V—VII produced ventrally at the apex; III about 4.76—5.38 times as long as its own width and 1.2—1.3 times the length of IV which is about 3.9—4.2 times as long as wide and 1.1—1.2 times the length of V; shape and chaetotaxy of segments as shown in figure. Sense cones slender and short (outer one on III about 40 μ long), distributed on inner (outer) surfaces as follows: III 1 (1), IV 1 (2) plus 1 ventrally, V 1 (1 + 2), VI 1 (0 + 1), VII 1 on dorsum. Mouth cone short, attaining about the middle of the prosternum; the acute labrum not quite reaching the broad rounded anterior margin of the labium.

Prothorax along median line of the pronotum about 0.5 times as long as the head and (including the coxæ) about twice as wide as long, very faintly sculptured along the posterior margin and the sides. Epimeron not fused with the pronotum. Usual setæ present, all slightly knobbed, excepting the antero-marginals which are

pointed, measuring as follows: antero-marginal 33—41 μ , antero-angular about 50—60 μ , mid-lateral 44—92 μ epimeral 102—133 μ , postero-marginal 77—105 μ , coxal 54—110 μ ; the epimerals arising from low tubercles. Fore legs enlarged, in the holotype measuring as follows: fore femora, length (width) 511 (210) μ , fore tibiae length (width) about 154 (85) μ ; fore tibiae with a distinct swelling on the inner surface near the apex; fore tarsi with a strong backwardly-curved tooth near the base, slightly longer than the width of the tarsus. „Sickle-shaped” spine at the apex of the fore femora absent, other setae slightly knobbed at the tip, those on the external basal angle measuring about 50 μ in length. Middle and hind legs normal. Pterothorax wider than the prothorax (including the coxae). Wings pad-like with two setae measuring about 79—87 μ and 154 μ respectively.

Abdomen rather broad, distinctly broader than the pterothorax, evenly narrowing from the second segment to the tube; the lengths in μ in the holotype of the segments VI—IX about 255, 244 and 189 respectively. Longest setae on segment IX constantly longer than the tube, 378—511 μ long. Tube 0.66—0.71 the length of the head and 2.68—2.90 its own greatest subbasal width which is slightly more than the apical width. Terminal setae shorter than the tube, 300—367 μ long.

Measurements of holotype (male) in mm. ... Length 4.77 distended; head, median dorsal length 0.522, width across eyes 0.243, width across cheeks at posterior angles of eyes 0.235, least width behind eyes 0.223, greatest width across cheeks near base 0.253, width across basal collar 0.258; head process in front of eyes, length 0.072, width at base 0.133, width at base of antenna 0.143; prothorax, median length of pronotum 0.284, width (including coxae) 0.551; pterothorax, greatest width 0.589; abdomen, greatest width (at segment II) 0.789; tube, dorsal length about 0.367, greatest subbasal width 0.128, least apical width 0.064.

Antennal segments	1	2	3	4	5	6	7	8
Length in μ	59	79	205	166	143	97	67	72
Width in μ	68	42	41	41	38	30	28	20

Total length of antenna 0.888 mm.

Female (brachypterous). Length 3.6 mm. General colour similar to that of male, differing in that the fore tibiae are dark and antennal segment IV is never distinctly paler in the middle. In structure it is also similar to the male, differing from the male in the points given below. The head is relatively shorter 2.02—2.26 times as long as wide across the eyes and 1.88—2.11 as long as the greatest width near the base; it is always narrower across the basal collar than

across the greatest width near base; cheeks relatively shorter, 1.45—1.63 times as long as the least width of the head behind the eyes. The head projection in front of the eyes somewhat shorter, 1.72—2.03 times as wide at base as long. Cheek spines shorter, the first 31—41 μ long. Antennal segment VIII as compared with VII longer.

Prothoracic setæ longer, their lengths in μ as follows: antero-marginal 31—51, antero-angular 36—72, mid-lateral 87—102, epimeral 118—159, postero-marginal 102—123, coxal 51—74. Setæ on fore legs weaker; tooth on fore tarsus very weakly developed, represented by an obtuse-angular swelling. Abdomen broader and not narrowing down so evenly to the tube. Tube relatively longer, 0.77—0.85 times the length of the head. Longest setæ on abdominal segment IX longer, 400—500 μ long.

Measurements of allotype (female) in mm. — Length 3.6 (normal); head, median dorsal length 0.539, width across eyes 0.246, width across cheeks a hind angle of eyes 0.241, least width behind eyes 0.230, greatest width across cheeks near base 0.261, width across cheeks near base 0.261, width across basal collar 0.248; head process in front of eyes, length 0.072, width at base 0.136, width at base of antenna 0.143; prothorax, median length of pronotum 0.278, width (including coxæ) 0.541; pterothorax, greatest width 0.656; abdomen, greatest width (segment) 0.789; tube, dorsal length 0.433, greatest subbasal width 0.069.

Antennal segments	1	2	3	4	5	6	7	8
Length in μ	59	72	197	161	136	97	67	79
Width in μ	68	42	40	41	37	32	29	21

Total length of antenna 0.868 mm.

Female (macropterous). The macropterous form of the female is identical with the brachypterous form except for the fully developed clear wings, with 17—26 duplicated cilia on the fore wing and subbasal setæ measuring as follows: a) 71—77 μ , b) 77—82 μ , c) 169 μ ; the first two are blunt and the third is pointed. Fore wing about 1.6 mm. long.

Described from 38 specimens, 15 males (all brachypterous) and 23 females (15 brachypterous and 8 macropterous) all collected in Pretoria, Transvaal, as follows: under bark of orange tree, 23-II-1939 (*E. Bedford*); on a dead branch of lemon tree, 21-I-1939 (*E. Bedford*); *Duranta* flowers, 24-I-1939 (*Miss A. F. Hean*); under bark of orange, 15-III-1939 (*E. Bedford*).

I take great pleasure in naming this new species after my father, whose interest and constant encouragement have always been of great help to me. There is little doubt that this species is viviparous as one of the females contained two well-developed larvæ in the abdomen.

The present species may be separated from all other South African species (except *E. oculus* Moulton, described from Abyssinia and now recorded from South Africa) by its short head, just about twice as long as width near base. From *E. gnidiicola* (Hesse) and *E. powelli* Jac.-Guil., the only previously known species with dark fourth antennal segments, it may further be separated by the absence of a „sickle-shaped” spine on the fore femora of the male, the shorter head process before the eyes, and the absence of a roughened area on the pronotum of the male. From *E. maynei* Pr. it differs in the paler antennal segment. *E. jeanneli* Bagn. and *E. laticeps* Bagn. differ in the paler IV and V antennal segments and the longer tube, while *E. breviceps* Bagn. differs in the shorter head, the greater number of duplicated cilia on the fore wing (44 compared with 24—26) and the shorter head process in front of the eyes. The species, however, to which the present one appears to be most closely related is *E. oculus* Moulton from which it differs as follows: — 1) the longer tube, 2) the paler head and prothoracic setæ, 3) the longer post-ocellar setæ as compared with the dorso-cephalic setæ (36—51 : 36—49 μ as compared with 21 : 56 μ), 4) the longer setæ on abdominal segment IX of the female, 5) abdominal tergum VII longer than VIII compared with shorter than VIII in the males of *oculus*.

***Elaphrothrips oculus* Moulton (Fig. 13).**

1928. Moulton, Ann. Mag. Nat. Hist., (10), II, p. 243.

Male (hitherto undescribed) (macropterous). Length 4.8 mm. (distended). General colour dark brown to black except the following: antennal segment II slightly paler at the apex, III pale brownish yellow with about the apical third shaded with brown, IV dark brown with the basal half a shade paler; fore tibiae and tarsi dark yellowish brown, the tooth of the tarsi the palest; articulation of the middle and hind legs greyish. Wings hyaline. Head and prothoracic setæ dark brown; abdominal setæ yellow with the outer pair on segment IX and the terminals shaded with brown at the base.

Head 2.31—2.39 as long as the width across the eyes and 2.17—2.23 as long as the greatest width across the cheeks near the base: weakly produced in front of the eyes, the process about 0.30—0.32 as long as the greatest width of the head across the cheeks, about 1.63—1.75 as wide at base as long and 1.72—1.88 as wide at base of the antennæ as long, slightly narrower at base than at the base of the antennæ, sides more or less straight. Cheeks diverging from shortly behind the eyes to near the base, flaring as usual to the eyes, forming short tempora. Head at the basal collar slightly wider than at its widest across the cheeks. Cheeks about 1.78—1.84 times

as long as the least width of the head a short way behind the eyes, set with about 5 slightly knobbed spines, the first the longest, 51—56 μ long. Post-ocular setæ slightly expanded near the tip, about 174—192 μ long, 49 μ from the eye and 133 μ apart; anteo-ocular setæ similar to the post-oculars, about 138 μ long. Post-ocular setæ small, pointed, about 21 μ long, much shorter than the dorsocephalic which are 56 μ long, 77 μ apart and 159—174 μ from the posterior margin of the eye. Eyes prominent, slightly bulging, with a slight notch near the posterior externa angles, about 0.25 the length of the head; their measurements in one cleared specimen as follows: length 143 μ , width 77 μ , interval 100 μ . Ocelli of the posterior pair with their fore margins in a line which would mark off about the anterior third of the eyes, their diameter about 21 μ , interval 69 μ and their distance from the median ocellus 74 μ . Antennæ slender, about 1.5—1.7 times as long as head; segments V—VII slightly produced ventrally at the apex; segment III about 4.51—5.11 times as long as wide and 1.22—1.29 times as long as IV; IV about 4.05—4.07 times as long as wide and 1.18—1.22 times as long as V. Sense cones short (outer on III 36—41 μ long) and slender, their distribution on inner (outer) surfaces as follows: III 1 (1), IV 1 (2) plus 1 ventrally, V 1 (1 + 2), VI 1 (0 + 1), VII 1 on dorsum. Mouth cone short, reaching about the middle of the prosternum, the acute labrum not quite reaching the broadly rounded fore margin of the labium.

Prothorax along the median line of the pronotum about 0.56 the length of the head and 2.01 as wide (including the coxæ) as long; faintly reticulate along the anterior and posterior margins, along the sides and median thickening. Usual setæ present, slightly knobbed excepting the fore marginals which are pointed; their measurements in μ as follows: antero-marginals 31, antero-angular 59, mid-lateral 79, epimeral 128, postero-marginal 102, coxal 102, the epimerals on slight tubercles and the coxals on distinct protuberances. Fore femora and tibiæ enlarged; in addition to the usual either blunt or slightly knobbed setæ and spines, a thick spine present at the outer hind angle about 41 μ and 10 μ wide at base; „sickle-shaped” spine at apex absent; tarsus with a strong tooth, longer than the width of the tarsus, and with a slight backward curve. Middle and hind legs normal. Wings well developed, fore wing about 1.51 mm. long and 0.123 mm. wide at middle, with 25—28 duplicated cilia; the subbasal setæ measuring as follows: a) 51—56 μ , b) 72 μ , c) 138—154 μ , the first two blunt and the third pointed. Pterothorax about as broad as the prothorax including the coxæ.

Abdomen broader than the pterothorax, broadest at segment II, thence gradually narrowing to the tube, the lengths of terga

VII—IX in μ as follows: 261, 274, 212, respectively. Longest setæ on segment IX about 456—473 μ long, constantly longer than tube which is about 0.75 the lengths of the head, 3.2 as long as the greatest subbasal width which is about twice the least apical width. Terminal setæ 344—367 μ long, shorter than the tube.

Measurements of allotype (male) in mm. Length 4.77 (distended); head, median dorsal length 0.600, width across eyes 0.251, width across cheeks at hind angles of eyes 0.238, least width behind eyes 0.223, greatest width across cheeks near base 0.264, width across basal collar 0.266; head process in front of eyes, length 0.082, width at base 0.138, width at base of antennæ 0.151; prothorax, median length of pronotum 0.289, width (including coxæ) 0.589; pterothorax, greatest width 0.589; abdomen, greatest width (segment II) 0.622; tube, dorsal length about 0.433, greatest subbasal width 0.133, least apical width 0.066.

Antennal segments	1	2	3	4	5	6	7	8
Length in μ	72	79	210	171	141	92	69	74
Width in μ	75	15	42	42	40	34	30	20

Total length of antenna 0.908 mm.

Female (macropterous). Length about 4. Omm. General colour similar to that of male except that segment IV of antenna is uniformly dark brown; the fore legs are the same colour as the middle and hind legs, generally only a dark brown and not black. Structurally the two sexes are also very similar, differing in that the female has a relatively shorter head, about 2.10—2.19 as long as width across eyes and 1.92—2.05 as long as the greatest width across the cheeks, the head being always narrower across the basal collar than at the greatest width across the cheeks; head process in front of eyes shorter, 1.80—1.97 times as wide at base as long; cheek relatively shorter, 1.60—1.77 times as long as the least width of the head behind the eyes; cheek spines shorter, the first 31—36 μ long. Prothorax along the median length of the pronotum relatively shorter, 0.43 the length of the head, and (including the coxæ) 2.32—2.42 as wide as long; prothoracic setæ usually longer, measuring as follows: antero-marginal 56 μ , antero-angular 56 μ , mid-lateral 107 μ , epimeral 159 μ , postero-marginal 128 μ , coxal 87 μ ; fore legs not greatly enlarged with weaker spines and tarsal tooth represented by a fairly sharp, obtusely angular swelling, directed slightly forward. Abdomen more rounded; tube longer, 0.86—0.90 the length of the head; longest setæ on segment IX usually longer, 522—533 μ long; terminal setæ 333—356 μ long, about the same length.

Measurements of female specimen in mm. — Length 5.13 (fully distended); head, median dorsal length 0.539, width across eyes

0.246, width across cheeks at hind angles of eyes 0.230, least width behind eyes 0.220, greatest width across cheeks 0.276, width across basal collar 0.266; head process in front of eyes, length 0.069; width at base 0.131, width at base of antennæ 0.138; prothorax, median length of pronotum 0.230, width (including coxæ) 0.556; ptero-

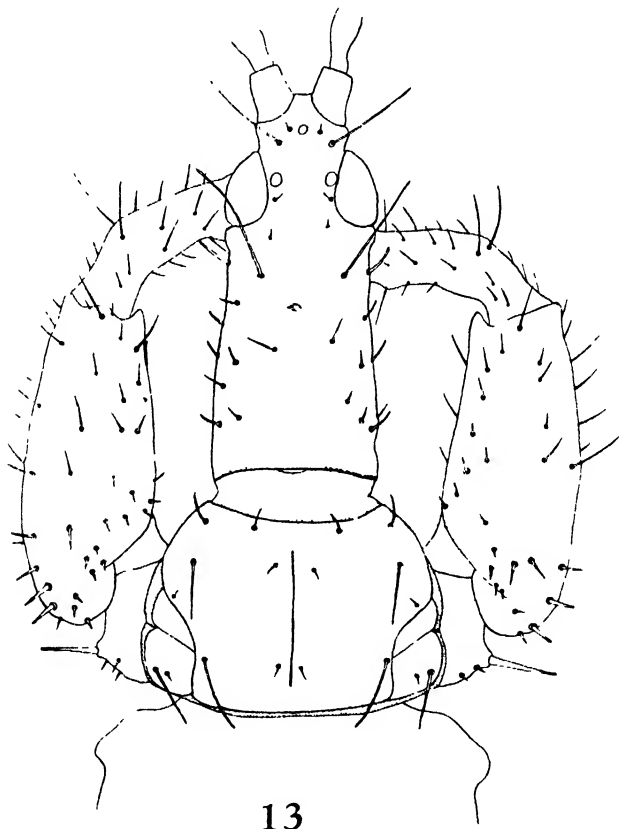


Fig. 13. *Elaphrothrips oculatus* Moulton, head and prothorax of male.

thorax, greatest width 0.611; abdomen, greatest width (segment II) 0.722; tube, dorsal length 0.173, greatest subbasal width 0.156, least apical width 0.064.

Antennal segments	1	2	3	4	5	6	7	8
Length in μ	61	79	200	161	128	92	67	77
Width in μ	66	45	42	42	11	33	29	21

Total length of antenna 0.865 mm.

The above description is based on 8 specimens, 3 males and 5 females, all macropterous, collected at the „Manor House”, Fort Beaufort, Cape Province, in dry pods of *Cassia lœvigata* L. on 30-III-1938 (*C. Jacot-Guillarmod*).

The above females agree very closely with Moulton's description of *E. oculatus* Moul., based on a unique female with most of the setæ rubbed off, the only difference being in the slightly broader head at the eyes and the position of the post-ocular setal pits; these latter he states are „placed about midway between posterior margin of eyes and posterior margin of head”. In the present specimens the dorsocephalic setæ are placed about midway between the posterior margin of the eyes and that of the head, thus it is probable that Moulton mistook the pits of the dorsocephalic setæ for those of the post-oculars. The slightly wider head does not seem to me a great enough difference to separate the present specimens from Moulton's species, especially when one takes into consideration the variation of the width of the head in *E. édouardi* described above. It will, however, only be possible finally to decide whether the present specimens are true *oculatus* after they have been compared with Moulton's type in the British Museum. For the present at least I think they are very well placed under this species.

***Elaphrothrips niger* sp. n. (Fig. 9, 10).**

Male (Macropterous) ... Length 5.0—5.2 mm. General colour very dark brown to black. Head black. Antennal segments I and II black, the latter of a dark greyish tinge at the apex; III very dark brown with only the basal seventh brownish yellow; IV—VIII uniformly very dark brown to black. Cheek spines black, the other head spines distinctly shaded with dark brown. Prothorax black; prothoracic setæ shaded with pale brown. Pterothorax black and dark brown on the membranous portions. Abdominal segment I dark brown, II and III almost black, the rest of the segments black; abdominal setæ pale yellow except those on segment IX which are pale brown and the terminals which are dark brown. Fore wings pale greyish brown, with a darker longitudinal line for about the median third; hind wing similar in colour to the fore wing but with the dark longitudinal line extending along about the basal half with the exception of the extreme base. All legs black with the exception of the trochanters and the middle and hind tarsi which are dark greyish brown, and the fore tarsi which are dark brown, slightly paler than the other tarsi, more especially the tooth which becomes paler towards the apex. Spines and setæ on the fore legs black except the „sickle-shaped” spine which is pale brown. Mesodermal pigmentation red.

Head short and broad, 1.99—2.11 times as long as width across

eyes and 1.91—2.04 as long as the greatest width across the cheeks; weakly produced beyond the eyes, the process twice or slightly more than twice as wide near the base as its own median length, about 2.2 as wide at the base of the antennæ as the median length and 0.24—0.27 as long as the greatest width of the head across the cheeks. Cheeks subparallel, diverging from near the eyes to near the base, then slightly converging to the basal collar (which is the widest portion of the head); flaring as usual to the eyes, slight indications of tempora present; the length of the cheeks about 1.53—1.60 as long as the least width of the head behind the eyes, set with about 7 or 8 pointed spines, the anterior one distinctly the longest, 56—69 μ long. Surface of head with fine cross lines. Anterior ocellar setæ bluntly pointed, about 131—159 μ long. Post-ocular setæ pointed, rather weak, about 51 μ long. Post-ocular setæ bluntly pointed, long, about 220—261 μ in length, 131—153 μ apart and 36—44 μ from the base of the eyes. Dorsoccephalic setæ well developed, bluntly pointed, 143—220 μ long, 74—87 μ apart and 133—148 μ from the base of the eye, thus longer than their distance from the eye. Eyes prominent, about a quarter of the length of the head; their measurements in μ in one of the paratypes as follows: — length 148, width 77—85, interval 123. Ocelli of the posterior pair with their fore margins in a line which would mark off about the anterior sixth of the eyes; in one of the paratypes their diameter 33 μ , interval 67 μ and 59 μ from the median ocellus which has a diameter of 31 μ . Antennæ about 1.64—1.71 times as long as the head, segments VI and VII produced below at the apex; segment III 4.39—4.60 times as long as wide and 1.24—1.25 times as long as IV; IV 3.38—3.61 times as long as wide and 1.14—1.18 times as long as V which is 3.3—3.47 as long as wide; lengths and chaetotaxy of the segments as in the figure. Sense cones short and weak (the outer on III about 34 μ long), distributed on inner (outer) surfaces as follows: — III 1 (1), IV 1 (2) plus 1 ventrally. V 1 (1), VI 1 (0 + 1), VII 1 on dorsum; IV and V have a varying number of rudimentary cones, IV with none to 2, while its formula on the left antenna of the holotype is 1 (3 + 2) plus 1 ventrally; V has a varying number (2 or 3) rudimentary sense cones, usually placed on the outer margin. Mouth cone short, rounded, reaching about the middle of the prosternum.

Prothorax along the median line of the pronotum about 0.5 the length of the head and (including the coxæ) not quite two-and-a-half times as wide as long. Faintly sculptured over its whole surface and in addition with a slight indication of a roughened area at the anterior end of the median thickening (very slight in comparison with that found in *powelli* Jac.-Guil. or *gnidicola* (Hesse)). Epimera not fused with the pronotum. Usual setæ present, bluntly pointed,

measuring as follows in μ : — antero-marginal 41—67, antero-angular 77, mid-lateral 133—148, epimeral 159—184, postero-marginal 194—205, coxal 112—131. Fore legs greatly enlarged, their measurements in the holotype in μ as follows: — femur, length 577, width 251; tibia, length 367, width 107; tarsus, width 72, tarsal tooth length 87; „sickle-shaped” spine well developed; tarsal tooth with a slight backward curve. Spines on femur pointed, those at the outer hind angle about 61 μ in length, long thin seta at about the middle of the outer margin measuring about 194 μ ; fore tibiae with a distinct swelling near the apex on the inner margin. Middle and hind legs normal. Wings broad, the fore pair about eleven times as long as the width at the middle, with 40—44 duplicated cilia along the hind margin; subbasal setae measuring as follows in μ : — a) 72—90, b) 105—120, c) 161—207; (a) and (b) blunt, (c) pointed or slightly lanceolate. In specimens that have no cover-glass pressure the pterothorax is slightly narrower than the prothorax (including the coxae).

Abdomen widest at base where it is narrower than either the pterothorax or the prothorax (including the coxae). The lengths of segments VII—IX in μ in one of the paratypes 264, 256, 205, respectively. Pores on terga I absent, on II 67—72 μ , III 61 μ , IV 61 μ apart. The longest seta on segment IX shorter than the tube, 456—477 μ long. Tube relatively long, 0.88—0.89 the length of the head and about 3.3 times as long as its greatest subbasal width which is 2.14—2.22 its least apical width. Terminal setae distinctly shorter than those on segment IX, about 344 μ long.

Measurements of holotype (male) in mm.: — Length (distended) 5.247; head, median dorsal length 0.589, width across eyes 0.289, width at hind angles of eyes 0.278, least width across cheeks 0.261, greatest width across cheeks 0.289, width across basal collar 0.307; head process in front of eyes, length 0.077, width near base 0.154, width at base of antennae 0.169; prothorax, median length of pronotum 0.289, width (including coxae) 0.711; pterothorax, greatest width 0.689; fore wing, length 1.900, width at middle 0.174; abdomen, greatest width (segment II) 0.533; tube, dorsal length 0.522, greatest subbasal width 0.159, least apical width 0.072.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	79	95	215	174	148	113	82	77
Widths in μ	80	46	49	51	45	38	33	22

Total length of antenna 0.983 mm.

Female (Macropterous). Length 5.8 mm. Very similar to the male in colour except that it is generally blacker; only the extreme

base of antennal segment III is brownish yellow; the fore tarsi are completely dark; the wings are practically colourless with no darker longitudinal line. In structure it is also very similar to the male, differing in the slightly shorter head process in front of the eyes, 2.21 times as broad near the base as long and 2.33 times as broad at the base of the antennæ as long; the generally shorter head setæ; longest cheek spine 49—51 μ long; ante-ocellars 128 μ long, the post-oculars 210 μ long and 138—146 μ apart; dorsocephalics 154 μ long and 95 μ apart; the relatively longer prothorax, 2.29 times as wide (including the coxæ) as long and 0.46 as long as the head; the distinctly shorter coxal setæ, 56—82 μ long. The fore legs are enlarged but not to such an extent as in the male, set with weaker spines and as in the case of alle females, a „sickle-shaped” spine on the femur is absent. The fore tarsus has a well developed tooth, not quite as strong as that of the male but of a similar shape, not quite as long as the width of the tarsus (similar to that in the female of *nigripes* Jac.-Guil.) Further the female differs in having fewer duplicated cilia (33—38 in number) on the hind margin of the fore wing. The tube is also longer, 1.00—1.03 times as long as the head.

Measurements of allotype (female) in mm. Length (nearly normal) 5.173; head, median dorsal length 0.578, width across eyes 0.284, width at hind angles of eyes 0.267, least width across cheeks 0.256, greatest width across cheeks 0.296, width across basal collar 0.300; head process in front of eyes, length 0.067, width near base 0.148, width at base of antennæ 0.156; prothorax, median length of pronotum 0.267, width (including coxæ) 0.611; pterothorax, greatest width 0.678; fore wing, length 2.055, width at middle 0.161; abdomen, greatest width 0.711; tube, dorsal length 0.595, greatest subbasal width 0.169, least apical width 0.069.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	79	85	215	169	146	105	79	79
Widths in μ	74	47	51	50	42	38	33	22

Total length of antenna 0.957 mm.

Described from six specimens, all macropterous, collected as follows: — 4 males, 1 female, in dry pods of *Cassia lavigata* L. (det. Miss H. Forbes) on 8-IV-1939 at Escombe, Natal (*C. Jacot-Guillarmod*); 1 female in dry pods of *Cassia* sp. on 21-IV-1935 at Pietermaritzburg, Natal, (*W. Powell*).

One of the males is gynæcoid and has a strong, slightly bent spine in place of the „sickle-shaped” spine; it differs further in being generally smaller, and the relative measurements do not quite agree with the above description; when, however, one notes the great difference that may exist between the gynæcoid and oede-

merous forms of other species, e.g. *E. productus* Priesner from the East Indies, then one may feel fairly confident that this specimen does belong to the present species.

The dark antennæ distinguish this species from all known *Elaphrothrips* except *maynéi* Priesner, *nigricornis* (Karny), (both African) and *unicolor* Moulton from Brazil. The well developed dorsocephalic setæ in addition to the dark antennae distinguish it from all known South African species except *gnidiicola* (Hesse). It may easily be separated from *unicolor* by the longer head process in front of the eyes (only one third as long as wide in *unicolor*), the well developed dorsocephalic setæ, and fewer duplicated cilia on the fore wing, (50 in *unicolor*). From *nigricornis* it differs in having antennal segment IV 1.09—1.19 times as long as V as compared with 1.8—1.9, the shorter head, only about twice as long as broad compared with 2.6 and the shorter head process in front of the eyes (over twice as broad as long compared with 1.5). From *gnidiicola* it may easily be separated by the darker antennæ, the shorter head (2.4 times as long as wide in *gnidiicola*) and the shorter head process. The species which appears to be most closely related to the present one is *maynéi*, the present species, however, differs in the narrower third and fourth antennal segments, 4.39 and 3.38 times as long as wide compared with 3.75 and 3.20—3.28 in *maynéi*; post-ocular setæ more than three times as far apart as their distance from the hind margin of the eyes as compared with about twice; longest seta on abdominal segment IX distinctly shorter than the tube and the well developed „sickle-shaped” spine in the male and a much larger and differently shaped tooth on the fore tarsus of the female; the present species probably also differs from *maynéi* in the development of the dorsocephalic setæ, as these are not mentioned in the description of that species and if they had been present could hardly have been overlooked. *E. nigripes* Jac.-Guil. which also has a well developed tarsal tooth in the female, differs in the colour of the antennæ, the longer head, the clear head setæ and in the short dorsocephalic setæ.

***Elaphrothrips transvaalensis* sp. n. (Fig. 11, 12).**

Male (Macropterous). Length 4.8 mm. (distended). General colour dark brown. Head dark brown at the base, becoming darker anteriorly until black between the eyes and on the head-process before the eyes. Antennal segment I dark brown; II dark brown, paler at the apex; III whitish yellow, shaded with brown for about the apical three-eighths, the basal three-eighths shaded with very pale brown; IV—VIII dark brown, VIII and the apex of VII a shade paler than the rest. Prothorax dark brown. Pterothorax dark brown, paler on the membranous portions. Abdomen dark brown at the

base, this portion distinctly paler than the head, thence gradually becoming darker towards the apex where it is almost black. All femora and tibiæ dark brown, slightly paler at the joints; all tarsi dark greyish brown; fore tarsal tooth paler, with a yellowish tinge. All setæ of a yellowish tinge, those on the ninth abdominal segments and the terminals with pale brown bases. Wings of a faint yellowish tinge. Mesodermal pigment present, bright cherry red.

Head 2.56 as long as the width across the eyes and 2.44 as long as the greatest width across the cheeks, which is near the base; head-process in front of the eyes 1.45 times as wide at the base as long and 1.51 as wide at the base of the antennæ as long, sides more or less straight. Cheeks subparallel, diverging from shortly behind the eyes to near the base where the head is widest, thence converging abruptly to form the basal collar; flaring as usual to the eyes; tempora absent; cheek 1.91 as long as the least width of the head behind the eyes, set with 4 or 5 slightly knobbed major spines, the first the longest, 56 μ long. Post-ocular setæ longer than the eye, blunt, 184 μ long, 115 μ apart and about 56 μ from the posterior margin of the eyes; dorsocephalic setæ pointed, about 72 μ long, 67 μ apart and about 205 μ from the posterior margin of the eyes. Eyes prominent, somewhat protruding, about 0.23 the length of the head; 136 μ long, 69 μ wide and with an interval of 97 μ . Ocelli of the posterior pair with their fore margins in a line which would mark off about the anterior quarter of the eyes, about 46 μ apart and 82 μ from the median ocellus, with a diameter of 18 μ . Antennæ slender, about 1.51 times as long as head, segments V—VII produced below at the apex; III and IV equal in length and 4.35 times as long as wide; IV 1.13 times as long as V; VII distinctly longer than VIII; the shape and chaetotaxy of the respective segments as shown in figure. Sense cones slender, the outer one on III 51 μ long; their distribution on the inner (outer) surfaces as follows: III 1 (1), IV 1 (2) plus 1 ventrally, V 1 (1), VI 1 (0 + 1), VII 1 on dorsum; V on the left side is as given above and on the right side is 1 (1 + 1). Mouth cone short, rounded, reaching about the middle of the prosternum.

Prothorax along the median dorsal length of the pronotum 0.35 the length of the head and about 2.25 as wide (including the coxæ) as long. The usual setæ present, rather abruptly pointed at the tip (except the antero-marginals, which are normally pointed, and the coxals which are knobbed), measuring as follows in μ : antero-marginal 44, antero-angular 67, mid-lateral 107, epimeral 118, postero-marginal 107, coxal 97. The epimerals and the coxal arise from distinct tubercles. Fore legs only slightly more enlarged than the middle and hind legs; fore femora 533 μ long and 141 μ wide, with a rather weak, „sickle-shaped” spine at the apex; fore tibiæ

378 μ long and 67 μ wide, set with spines placed on low but distinct tubercles; fore tarsus with a nearly straight, rather narrow tooth at the base, about as long as the width of the tarsus and directed distinctly forward. Middle and hind legs normal. Wings fully developed, the fore wing nearly 13 times as long as width at the middle, with 26—27 duplicated cilia; the measurements in μ of the subbasal setæ of the fore wing as follows: a) 66, b) 79, c) 143—154, all blunt. Pterothorax distinctly wider than the prothorax (including the coxæ).

Abdomen narrow, widest at segment II where it is narrower than the pterothorax, thence gradually narrowing to the tube. Lengths of the terga VII—IX in μ as follows: 261, 271, 205 respectively. Longest setæ on segment IX 433 μ long, longer than the tube. The tube 0.65 the length of the head and 3.2 times as long as its own greatest subbasal width which is about twice its least apical width. Terminal setæ 344 μ long, shorter than the tube.

Measurements of holotype (Male) in mm. Length (distended) 4.8; head, median dorsal length 0.589, width across eyes 0.230, width across cheeks at hind angles of eyes 0.215, least width behind eyes 0.207, greatest width across cheeks near base 0.241, width across basal collar 0.238 headprocess in front of eyes 0.085, width at base 0.123, width at base of antennæ 0.128; prothorax, median length of pronotum 0.207, width (including coxæ) 0.466; pterothorax, greatest width 0.600; abdomen, greatest width (segment II) 0.556; fore wing, length 1.651, with at middle 0.128; tube; dorsal length 0.384, greatest subbasal width 0.120, least apical width 0.061.

Antennal segments	1	2	3	4	5	6	7	8
Lengths in μ	51	77	174	174	154	105	82	74
Widths in μ	62	40	40	40	36	29	24	17

Total length of antenna 0.891 mm.

Described from a single gynæcoid macropterous male collected at the Woodbush, Pietersburg, Transvaal, by „sweeping”, 17-IV-1924 (*J. C. Faure*).

The length of the fourth antennal segment being equal to the third distinguishes this species from all African species excepting *E. bottegoi* (Buffa) and also *E. congoënsis* Priesner, which sometimes has these two segments subequal. From *congoënsis* it may easily be separated by the colour of the fourth antennal segment, the presence of a „sickle-shaped” spine, and the well developed cheek spines. From *bottegoi* it may be separated by the colour of the antennæ, in which only the terminal third of IV and the apical half of V are dark. I am greatly indebted to Dr. Priesner of Cairo for having compared this specimen with his *Elaphrothrips* material, and for confirming my view that it is an unnamed species.

The body temperature of *Samia cecropia* Linn. (Lepidoptera, Saturniidae) as influenced by muscular activity *)

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From a review of the voluminous literature on the body temperature of insects, it is apparent that the available data are rather fragmentary and in some cases inexact. For example, the temperature of the same species has, in some instances, been found to be higher and in others to be lower than that recorded for the surrounding atmosphere. This lack of uniformity in results may be attributed to faulty technique, inaccuracy of the apparatus used, or to conclusions based on an insufficient number of observations.

Apparently the only references dealing with temperature variations in the different regions of the insect's body are those of Dutrochet (1840), Girard (1869) and Himmer (1925).

Review of the literature.

As an admirable discussion on the body temperatures of different species of insects appears in Uvarov (1931), it is advisable to review only those publications dealing with the regional temperatures of the body of the insect. Hausmann (1803) is credited with having been the first investigator to demonstrate the production of heat by the individual insect. In 1840 Dutrochet observed that the temperature of the thorax of an insect may be slightly higher than that of its abdomen. His observations were obtained with a thermocouple made of iron and copper wires. The monumental work of Girard (1869) covers in detail some of the phases of this problem. He employed three methods for body temperature measurements viz., the thermoelectric method, the mercury thermometer and the modified differential thermometer of Leslie. Leslie's thermometer is, however, very slow in registering temperature differences. It also requires a fairly long interval before coming into equilibrium with

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the surrounding air temperature. A few excerpts from his extensive studies are given in Table 1.

Table 1: Temperature increases due to muscular activity in different species of Lepidoptera (Girard 1869).

Species	Temperature °C of the	
	Abdomen	Thorax
<i>Sphinx ligustri</i>	Rises from 20.0 to 22.0	Rises instantaneously to 25.0.
<i>Attacus pyri</i>	Rises from 15.0 to 15.3	Rises rapidly to 16.4
<i>A. carpm</i>	Rises from 13.8 to 14.4	Rises to 15.4
<i>Deilephila elpenor</i>	Rises from 15.0 to 15.4	Rises to 16.0
<i>Acherontia atropos</i>	Rises from 25.2 to 26.0 in a few secs.	Rises to 30.0 in 30 secs.

Himmer (1925) determined the regional body temperatures of several species of insects. In his observations on bees he found that the average temperature of the thorax exceeded that of the abdomen by 6.1 ° C in the drone and 4.4 ° C in the worker bee.

According to Newport (1837) many of the earlier temperature readings were made with the aid of mercury thermometers, „of the smallest possible calibre, with cylindrical bulbs about one-half inch long and scarcely larger than crow quills”. Needless to say such thermometers gave only a rough approximation of the actual conditions as they absorbed a fair proportion of the heat given off by such feeble thermometric sources as insects. Later, with a better understanding of the Seebeck effect (1827), thermoelectric needles or thermocouples came into general use. Nobile and Melloni (1335) are regarded as having been the first research workers to use thermocouples for measuring temperature differences in the insect's body.

Experimental method.

These observations embrace a study of the influence of muscular activity on the temperatures of the thorax and abdomen of *Samia cecropia* Linn., a North American species of moth. Special attention was given to the problem of maximum temperatures which may be attained by this species.

The apparatus used in these measurements consisted of a Type

K potentiometer for measuring the electromotive force generated in the thermocouples, a Type R d'Arsonval galvanometer, a storage

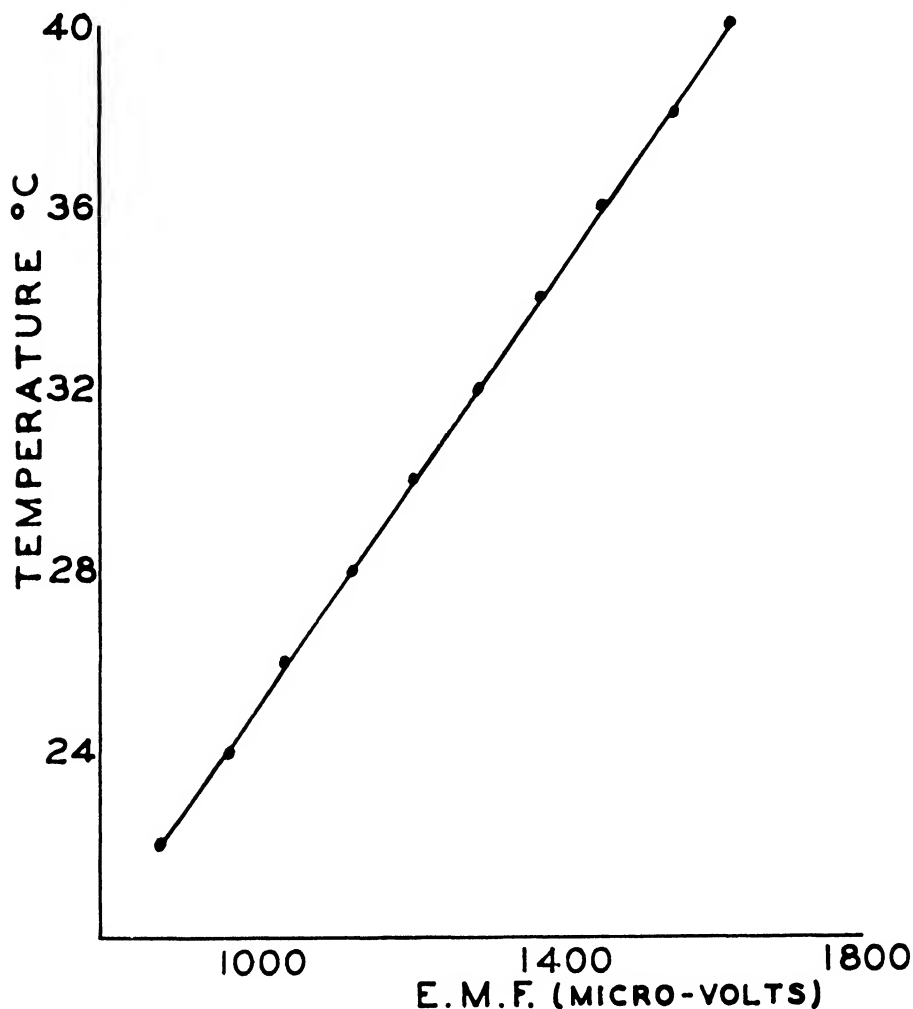


Figure: 1: — Thermoelectric diagram of e.m.f. of copper and constantan.

battery, a standard cell and a cold junction. As sensitivity, critical damping resistance and the period of a galvanometer are of major importance in this type of study, an instrument having the following characteristics was selected: — sensitivity, 0.0005 micro-

ampere per mm. at one meter; damping resistance, 10,000 ohms; period, 6 seconds, and coil, 500.

The thermocouples used were made of No. 33, B. and S. gauge, enamelled and double cotton-covered copper and constantan wires. After the wires had been thoroughly cleaned they were twisted around each other and dipped into molten solder. The tip was cut off with scissors so as to leave a junction 0.5 to 1 mm. in length. The junction was insulated by means of bakelite, so that the measurements taken where the needle was introduced into the body of the insect could not be influenced by the electro-chemical action of the insect's body fluids on the needle. The thermocouples were calibrated against a Bureau of Standards thermometer (Washington D. C., U. S. A.).

If the data are plotted with the temperatures of the hot junction as abscissas and electromotive force as ordinates a graph such as shown in figure 1 is obtained.

Many references to the construction of extremely sensitive thermocouples may be found in the literature. For a better understanding of the principle involved and the art of thermocouple construction, the excellent publications of White (1914), Robinson (1927) and Karrer and Estabrook (1930) may be consulted.

After weighing the moth, it was fastened to a piece of cork by means of a silk thread placed over its thorax between the meso- and meta-thoracic wings. One thermocouple was pushed into its anus to a depth of 1.2 cm., and the other inserted laterally through the intersegmental membrane between the meso- and meta-thorax to a depth of 7 mm. Care was taken to insert the thermocouples to equal depths in individuals of the same size, weight and age.

The moths were activated by lightly touching their antennæ with a small brush. When activated wing movement was either even, regular or uniform, or irregular. This even wing movement or vibration may be referred to as humming or buzzing (German, *summen*) and the irregular movements as fluttering (German, *flattern*). Observations on the activity of the moth and on its thoracic and abdominal temperatures were made at frequent intervals. Determinations were made on 50 individuals; data and graphs on only three are given as these are typical examples.

Discussion of the results.

The data obtained on a male moth, 4 days after emergence and weighing 1.04 gram are given in table 2. Thermocouples were inserted at 10.13 a.m. and removed at 2 p.m. The first observations were made at 10.42 a.m. The individual died five days later. As the mean length of adult life varies from 8 to 10 days, it is evident that the insertion of the thermocouples did not seriously injure the moth.

The temperature of the surrounding air varied from 26.1 ° to 26.6 ° C. during the course of the experiment.

Table 2: The influence of muscular activity on the thoracic and abdominal temperatures of a male moth.

Time	Temperature (°C) of		Remarks
	Abdomen	Thorax	
10.42 a.m.	26.6	26.3	Moth quiet.
10.45	26.5	26.2	Moth quiet.
10.51	26.4	26.1	Moth quiet.
10.52			Activated with brush; Flutters for ½ minute then hums.
10.52½		27.1	
10.53		29.1	Hums or buzzes.
10.54	27.1	32.2	Hums or buzzes.
10.55		35.4	Hums or buzzes.
10.56		37.4	Starts fluttering very fast for 1 minute.
10.57		37.7	Flutters fast.
10.57½		37.2	Flutters more slowly.
10.58			Starts humming.
10.58½		38.1	Hums, then flutters.
10.59	28.9	37.8	Stops fluttering at 11 a.m. for a few seconds.
11.01		37.4	Hums for half-minute then flutters slowly.
11.02	30.2	36.7	Quiet.
11.03	29.4	32.9	Quiet.
11.04	29.1	31.9	Quiet.
12.42 p.m.	26.9	26.9	Evidently quiet from 11.04 a.m.
12.44			Irritated with brush Flutters for 20 seconds then hums.
12.45	27.3	29.9	Hums.
12.46	28.1	34.5	Hums.
12.47		26.5	Hums, then flutters.
12.48		36.5	Flutters.
12.49		36.5	Flutters.
12.49½		36.0	Flutters then hums.
12.50		37.1	Hums.
12.50½		37.3	Hums, then flutters.
12.51		37.2	Flutters, then hums 20 seconds later.
12.52		37.3	Hums, then flutters.
12.53	30.0	36.7	Stops fluttering.
12.55	29.8	32.5	Quiet.
12.56	29.5	30.9	Quiet.
12.57	29.2	30.1	Quiet.
12.58	29.0	29.3	Quiet.
1.00	28.6	28.5	Quiet.
1.01	28.4	28.1	Quiet.
1.02	28.1	27.9	Quiet.
1.04	27.8	27.6	Quiet.

Table 2 (continued).

Time	Temperature (°C) of		Remarks
	Abdomen	Thorax	
1.06	27.5	27.3	Quiet.
1.09		27.0	Quiet.
1.09½			Spontaneous humming.
1.10½		31.2	Hums.
1.11		33.2	Hums.
1.12		36.8	Starts fluttering.
1.13		36.9	Flutters.
1.14	29.1	37.0	Flutters.
1.15	29.4	36.6	Flutters.
1.16	29.7	36.4	Stops fluttering at 1.16½.
1.17		36.2	Quiet. Starts humming 10 seconds later.
1.18	30.4	37.2	Flutters for 40 secs.
1.19½			Starts humming.
1.20		37.0	Starts fluttering.
1.20½		36.6	Flutters, then quiet for 1 min.
1.21½			Starts humming.
1.22		37.0	Hums then flutters for 5 secs.
1.23½	30.8	34.7	Quiet.
1.25	30.3	32.0	Quiet.
1.26		30.9	Quiet.
1.27	29.4	30.0	Quiet.
1.29	29.1	28.9	Quiet.
1.30	28.8	28.6	Quiet.
1.31	28.6	28.2	Quiet.
1.33	28.2	27.9	Quiet.
1.34	28.0		Irritated with brush. Flutters for 40 secs. then hums.
1.35	28.1		Hums.
1.36	28.6	28.3	Hums.
1.36½		36.9	Hums then starts fluttering.
1.37	29.3		Flutters.
1.38	29.5	36.6	Flutters then starts humming at 1.38½.
1.39	29.7	36.8	Hums, quiet for 20 secs. then hums for a few secs.
1.40		26.9	Flutters.
1.41	30.3	35.3	Quiet until 2.00 p.m. Temperatures taken at frequent intervals.
1.42	30.2	34.1	
1.50	28.3	28.1	
1.57	27.3	27.3	
2.00	27.2	27.2	

The data, as presented graphically in figure 2, show that the moth is able to raise the temperatures of its abdomen and thorax to a maximum of 30.2 ° and 38.1 ° C respectively, after continuous muscular activity of about 6 minutes. This was 12 degrees above

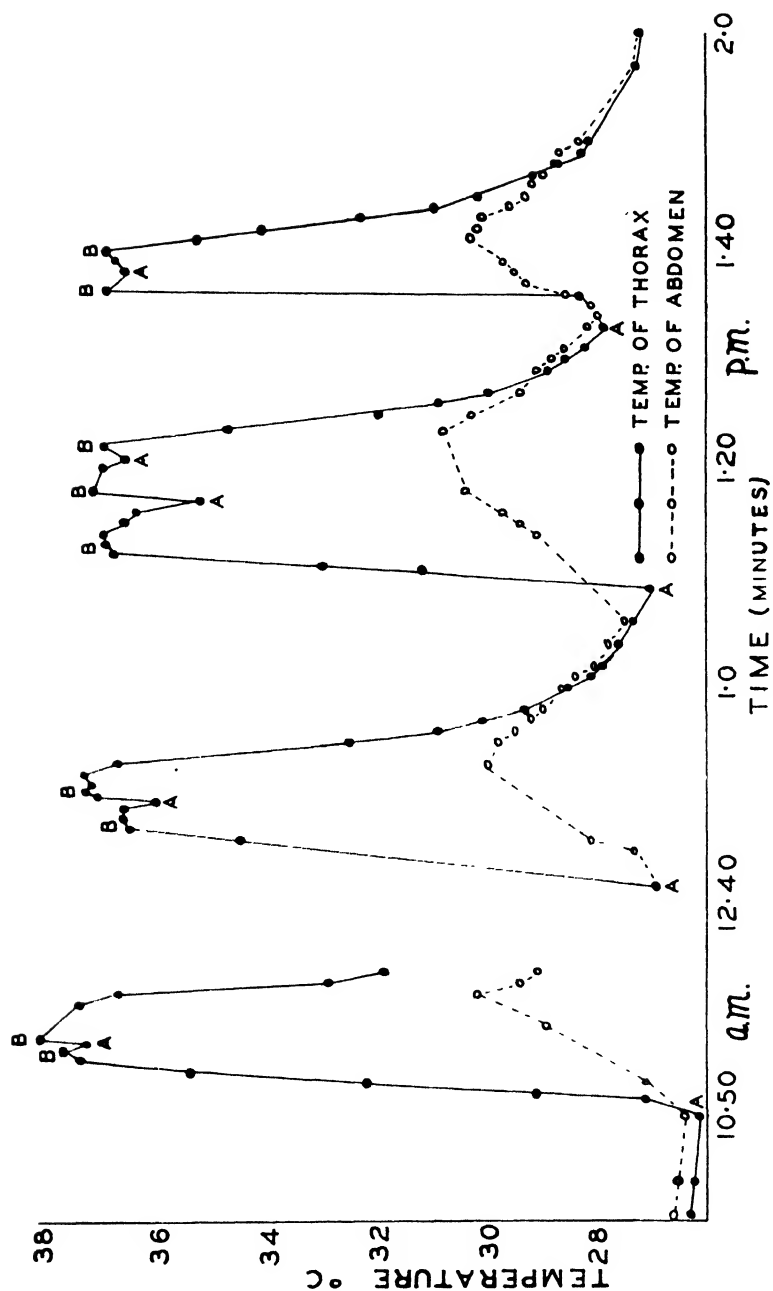


Figure 2: — The influence of muscular activity on the abdominal and thoracic temperatures of a male moth, 4 days after emergence. In the diagram A to B denotes the period of wing movement.

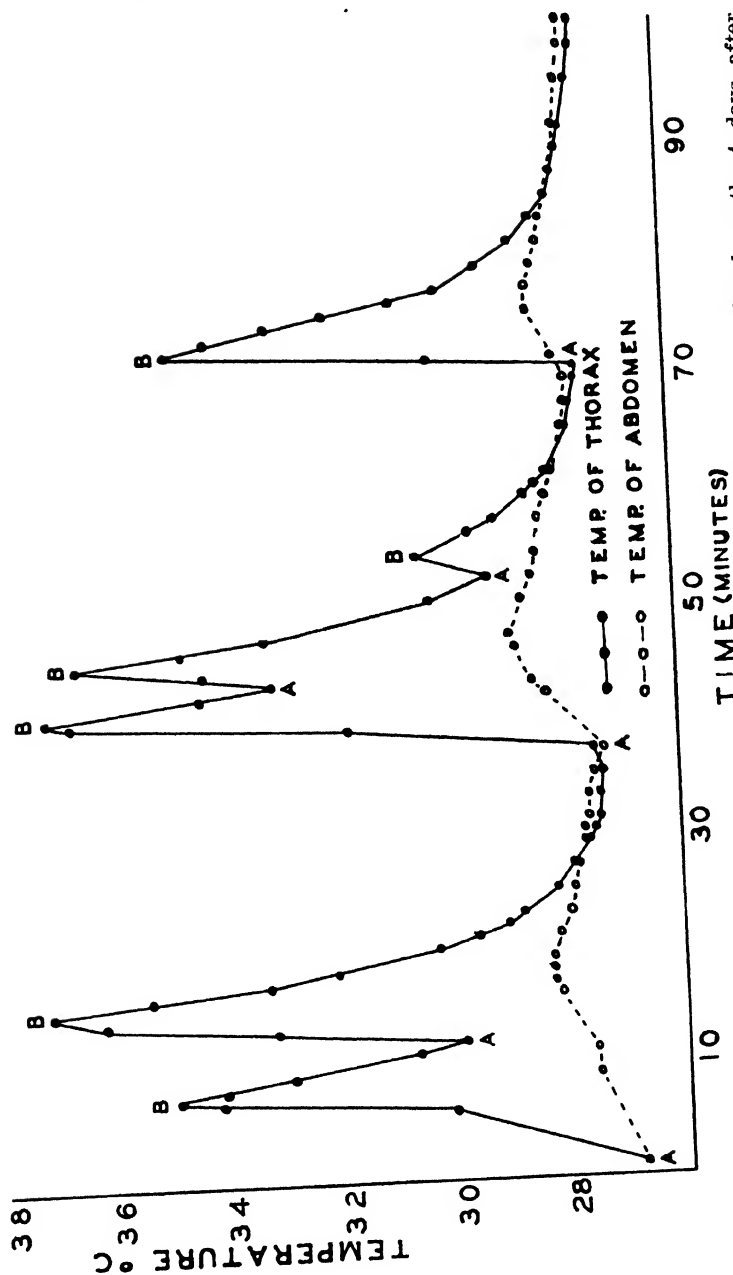


Figure 3: — The influence of muscular activity on the body temperatures of a female moth, 4 days after emergence. In the diagram A to B denotes the period of wing movement.

the temperature of the surrounding air. Continuous muscular vibration (humming) for 1.5 minute may raise its thoracic temperature from 27.0° to 36.8° C i. e. through 9.8 degrees. A maximum abdominal temperature of 30.8° C, which was 4.2 degrees above the temperature of the air, was registered. This rise in the temperature may to some extent be accounted for by the muscular activity of the abdomen. Conductivity through the body tissues and along the body wall, as well as circulation of the plasma from the thorax to the abdomen may also aid in the transference of heat from the thorax to the abdomen.

When the individual comes to rest there is at first a sharp decline in the temperature of the thorax, followed by a more gradual decrease as the temperature approaches that of the surrounding air. Later the temperature of the thorax drops to slightly below that

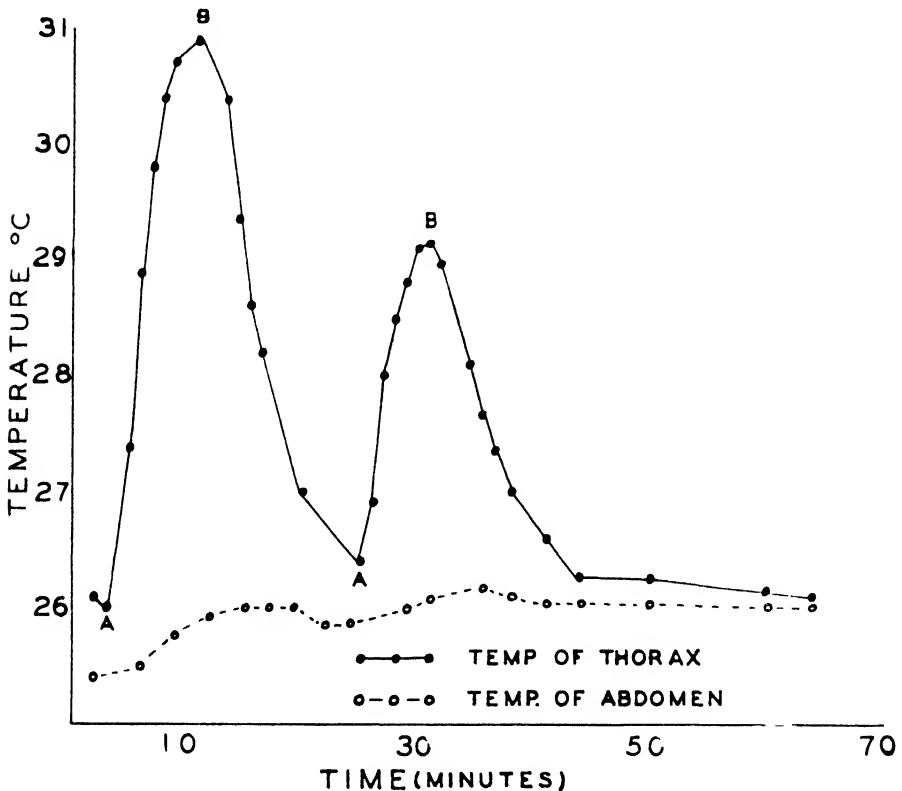


Figure 4: — The influence of muscular activity on the body temperatures of a male moth, 7 days after emergence. In the diagram A to B denotes the period of wing movement.

of the abdomen. This decrease to a point below the temperature of the abdomen is probably due to the evaporation of the body fluids from the incision made by the thermocouple.

The data obtained on a female, 4 days after emergence and weighing 2.76 grams, are presented graphically in figure 3. This individual was kept under observation for a period of 100 minutes. It was very active and muscle vibration was spontaneous in most instances. The diagram shows that when active this female was able to raise the temperature of its thorax through 9.3 degrees and that of its abdomen through 2 degrees. The results further demonstrate that the temperature of the thorax could be raised to the same maximum by spontaneous muscular movement as by movement resulting from artificial excitation.

In figure 4 the data obtained with a male, 7 days after emergence and weighing 1.00 gram are presented. This specimen was very inactive as compared with the previous two. Its wing muscles also appeared to be much less flexible. It was only able to raise the temperature of its thorax through 5.5 degrees and that of its abdomen through 0.8 degree.

Conclusions.

1. The heat produced by a moth is proportional to its muscle activity, being greater with muscle vibration (humming) than with fluttering.

2. Spontaneous muscular activity is able to raise the temperature of the thorax to the same level as activity resulting from artificial excitation.

3. The male of this species can evidently produce more heat than the female when taken in a similar state of activity.

4. The ability of the moth to raise its body temperature decreases with age.

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Preliminary field experiments on the attractiveness of certain chemicals and bait carriers to the hoppers of the brown locust

by

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INTRODUCTION.

In March 1935, at the end of the very extensive campaign of 1934—1935, field experiments were being conducted with the object of studying the technique of the application of bait against the hoppers of the brown locust. During the campaign, serious stock losses had resulted from excessive spraying with sodium arsenite solution, and this led to agitations against its use by the farming community. It was consequently felt that for future campaigns the policy of large scale spraying would have to be abandoned, and that the use of sodium arsenite would have to be limited as far as possible.

Although baiting had for many years been recommended by the Department of Agriculture as being preferable to spraying, this method had not been adopted as the standard method of hopper destruction, since it was considered that sufficient quantities of a cheap carrier would not be available for extensive campaigns. Bait made from horse or donkey dung, picked up on the veld, had at various times been used by locust officers with good results on a fairly extensive scale in certain districts. Various other bait carriers, such as finely cut green forage or grass, wheaten bran and maize bran had also been employed by farmers on a small scale, but very little information was available on the comparative values of the different bait carriers.

Although Mally (1923) had reported, on the basis of field tests, that molasses did not add to the attractiveness of materials treated with arsenite of soda, field officers persisted in maintaining that molasses was a necessary ingredient in poison baits.

The preliminary experiments discussed in this paper were undertaken with the object of throwing some light on the gustatory and/or olfactory reactions of the brown locust hopper by comparing: —

(a) the attractiveness or palatability of certain poisons which could be used in baits, and some other substances which could possibly be used to render baits more attractive;

(b) the attractiveness or palatability of poison baits made of different carriers, with and without potential attractants or taste improvers; arsenite of soda was used as the poisonous principle in these baits.

The experiments were conducted about 38 miles east of Upington, near the main road from Upington to Olifantshoek on sandy dune veld, with a sparse covering of grasses consisting mainly of the following species: — sweetgrass (*Eragrostis* spp.), kringpolgras and steekgras (*Aristida* spp.). The grasses were about 6" to 18" in height, and mostly dry, but occasional green tufts could be found.

The weather was warm, and no rain had fallen for two or three weeks previously. The sky was cloudless when the experiments were conducted.

TECHNIQUE.

A portion of a band of hoppers of the phase *gregaria* was confined in the experimental area by means of a galvanized iron barrier 18" high, erected in the form of a circle 96 feet in circumference. The barriers were erected in the evening, soon after the hoppers had settled in clusters for the night.

Inside the barrier a number of square plots, with sides $2\frac{1}{2}$ ft. in length, were prepared by removing all vegetation and stones. Uncleaned strips of about one foot separated the cleaned plots. The plots were laid out early in the morning while the hoppers were inactive and clustered, mostly along the sides of the barrier. The laying out of the plots did not greatly disturb the enclosed hoppers. The number of plots laid out corresponded with the number of treatments and replications in the experiment. The materials to be tested were placed in the centres of the plots on the soil in square wooden frames with sides 6 inches in length, made of strips of wood 1" wide $\times \frac{1}{2}$ " thick. In most cases the wooden frames were filled to the top with the materials to be compared. The materials were placed in the plots before hopper activity commenced. The layout of the plots was on the random block system, with four replications. The wooden frames in the control plots contained only sand.

Counts of the hoppers seen on the various plots were made by an observer with the aid of field glasses. The observer took up a position in the centre of the enclosure on a tower six feet in height. Only hoppers seen in the small wooden frames were counted. The observer made rapid counts; he began with block A, taking counts in the plots from left to right, and then proceeded in turn to block B, C and D in the order named. The observer communicated his readings to a recorder sitting outside the barrier; usually recorder and observer changed places after each complete set of counts. Each set of counts took about 10 minutes to complete.

The first count of hoppers was usually taken when the conditions were suitable for feeding but not for trekking, i. e. when the temperature was between 63 ° F. and 70 ° F. In some cases counts were taken subsequently at regular intervals. Observations were discontinued when the temperature had risen to above 90 ° F., when the hoppers were taking shelter, or when a large proportion of the contents of some of the wooden frames had been removed by the hoppers.

At the higher temperatures the hoppers marched in narrow columns, over and between the plots; the columns would unite and break up at intervals. The hopper columns covered the enclosed space more or less evenly, and apart from the fact that the treatments were well replicated and allocated at random in each block, the different plots had more or less the same chances of being visited by approximately equal numbers of hoppers.

Except for the fact that the hoppers repeatedly retraced their steps over the same ground, they behaved just like those in bands marching across the open veld. It was not observed that the heat inside the barriers had any detrimental effect on the hoppers.

Some of the individuals belonging to a band or strip of hoppers would stop on one of the plots, and subsequently join one of the adjacent hopper bands. It was apparent that hoppers were detained for longer periods on certain plots than on others. When the trekking movement was in full swing, hoppers which had moved over the experimental area, worked their way along the sides of the barrier to return to the original starting point, and then proceeded to move over the same area again.

In these experiments the relative attractiveness or palatability of the various materials tested was determined by a comparison of the number of hoppers observed on the different plots. The number of hoppers observed on any plot may be due to the palatability of the substance in the plot causing the hoppers to stay longer than on an untreated or less attractive plot, or to factors other than gustatory, for example attraction at a distance (olfactory attraction) or to several factors combined. In experiments of this nature it is not possible to distinguish between the gustatory and olfactory reactions of the hoppers.

In some of the experiments the comparative number of hoppers visiting certain materials was not taken as the sole criterion of their relative attractiveness, but in addition readings were taken to determine the amounts of the various materials which had been consumed. It was not possible to weigh or measure the residue which remained unconsumed in the plots, but estimates were made independently by two observers, and the mean of the two estimates was adopted as the final figure.

There is probably a limit to the number of hoppers that should be encircled in an enclosure. If overcrowded, the hoppers will be forced on to the materials, and the numbers observed will therefore not be a true reflection of the attractiveness or palatability. The writers are of the opinion that the locusts caught should cover approximately half of the area of the circle or enclosure when at rest for the night.

EXPERIMENTS WITH CHEMICALS.

Experiment No. 1 (2nd instar hoppers; date 8/3/35).

A trial experiment was conducted to test the technique and the following treatments were used: —

1. Sodium arsenite, fine powder.
2. Sugar, fine white crystalline.
3. Salt (Na Cl) coarse, as used for cattle.
4. Sodium acid phosphate, fine powder.
5. Barium fluosilicate, fine powder.
6. Control: frame filled with sand.

Plan showing randomization of treatments.

Block \ Plot						
	1	2	3	4	5	6
A	6	3	5	2	4	1
B	1	6	4	5	2	3
C	3	4	2	6	1	5
D	2	5	1	3	6	4

The treatments were replicated four times. In each block the plots were allocated at random to each treatment. Only one count was taken on each plot in this experiment. Temperatures were not read while the hoppers were counted, but temperature readings taken in the vicinity at 9.20 a.m. by means of a whirling hygrometer gave the figures: temperature 79° F., relative humidity 33 %.

Significant difference between any two means is 37, at $P = 0.05$.

On the basis of the averages in table 1, the following conclusions can be drawn: —

- (1) Salt was the most attractive or palatable of all treatments.
- (2) Sodium arsenite and sugar were significantly more attractive than the control.
- (3) Sodium acid phosphate and barium fluosilicate were not significantly more attractive than the control.

Table 1: Number of hoppers which visited each treatment at 10.45 a.m. in experiment No. 1.

	Sodium arsenite	Sugar	Salt	Sodium acid phosphate	Barium fluosilicate	Control	Totals
A	46	14	48	22	3	0	133
B	7	15	24	30	0	0	76
C	70	40	130	15	0	0	255
D	40	80	120	30	0	0	270
Totals	163	149	322	97	3	0	G.T. 734
Average	40.75	37.25	80.5	24.25	0.75	0	

Table 1a: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log_e$ mean square	z	z at P = 0.05
Blocks	3	4450.2	1483.4	3.6510	0.9038	0.5326
Treatments	5	18019.8	3604.0	4.0949		
Error	15	8865.8	591.1	3.1911		
Total	23	31335.8				

Experiment No. 2 (2nd instar hoppers; date 9/3/35).

The results of the second experiment are considered to be more reliable than those of the first, since more counts were taken in the second. The same chemicals were used, except that sodium fluoride was added in experiment No. 2: —

1. Sodium arsenite.
2. Sugar.
3. Salt.
4. Sodium acid phosphate.
5. Barium fluosilicate.
6. Sodium fluoride powder.
7. Control: frame filled with sand.

Plan showing randomization of treatments.

Block \ Plot	1	2	3	4	5	6	7
A	1	2	3	4	5	6	7
B	4	1	5	7	2	3	6
C	3	5	2	6	4	7	1
D	2	7	6	3	1	5	4

Treatments were replicated four times. In each row plots were allocated at random to each treatment. Counts were taken a four different times and the figures were added together to give one reading for each plot, or treatment.

The four counts were made at the times and under the conditions specified below: —

	Time a.m.	Temperature °F.	Relative humidity %	Remarks on behaviour of hoppers in enclosure.
1.	8.25	78	40	no general migration.
2.	9.40	88	30	general migration in progress
3.	10.	89	35	general migration in progress; some hoppers taking shelter.
4.	10.50	92	19	some migration still taking place over whole enclosure, but majority of hoppers at rest.

Table 2: The total number of hoppers which visited each treatment during the four counts in experiment No. 2.

	Sodium arse- nite	Sugar	Salt	Sodium acid phos- phate	Barium fluosi- heate	Sodium fluoride	Control	Total
A	17	43	159	188	7	58	16	488
B	5	28	123	172	10	38	4	380
C	24	97	250	122	17	20	10	540
D	21	109	135	145	9	39	4	462
Total	67	277	667	627	43	155	34	G.T. 1870
Average	17	69.3	164.3	156.8	10.8	38.8	8.5	

Table 2a: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square $\div 100$	%	value of z at $P = 0.05$
Blocks	3	1909.00	636.3	0.9251	—	—
Treatments	6	111677.22	18612.87	2.6131	1.5090	0.4894
Error	18	16386.5	910.36	1.1041		
Total	27	129972.72				

Significant difference between any two means is 45, at $P = 0.05$.

Referring to the averages arrived at in table 2, the following conclusions can be drawn: —

(1) Salt and sodium acid phosphate are equally attractive, and more attractive or palatable than all the other substances, and also more attractive than the control.

(2) Sugar is more attractive or palatable than the control, sodium arsenite and barium fluosilicate, but it is not more attractive than sodium fluoride.

(3) Sodium arsenite, barium fluosilicate and sodium fluoride are not more attractive or palatable than the control.

In the case of experiment No. 1 no readings were taken to indicate the quantities of the various dry materials consumed. The general impression gained was that the salt and sodium acid phosphate decreased to a greater extent than the other materials.

In the case of the second experiment, readings were only taken 24 hours after the experiment had been concluded, and these readings can therefore not be considered as very reliable, since wind could have removed some of the material. At the time these readings were taken about 100 % of the hoppers inside the barrier had died. The results arrived at were: —

	Sodium arsenite	Sugar	Salt	Sodium acid phosphate	Barium fluosilicate	Sodium fluoride
Percentage consumed	10	34	36	73	58	79

Since only small quantities of barium fluosilicate and sodium fluoride were available and smaller amounts were placed in the plots, it is possible that a smaller percentage of these two chemicals was consumed than estimated.

It is also interesting to note that a fairly large percentage of the salt, which was fairly coarse in texture, and an even larger percentage of the sodium acid phosphate, had been consumed at the conclusion of the experiment. It is a well known fact that the area in which the experiments were conducted is subject to gallamsiekte in cattle, a disease primarily due to phosphorus deficiency in the grass. „This suggestst” says Faure (1935) who experimented with sodium arsenite and salt as attractants in the same area, „that the appetite for arsenite of soda and for salt displayed by *Locustana pardalina* may be connected with deficiencies in its grass diet in the Kalahari region.”

In this experiment sodium arsenite was not significantly more attractive or palatable than the control, but there appeared to be a definite craving for salt and phosphate. Although sugar was slightly more attractive than the control, it does not appear that the hoppers had any special craving for it.

EXPERIMENTS WITH POISON BAITS.

At this stage it was considered that baits of various compositions should be tested in order to compare different carriers and potential attractants in conjunction with the poisonous principle, namely sodium arsenite.

Experiment No. 3 (2nd instar hoppers; date 11/3/35).

The attractiveness of the following baits was tested in two differentt enclosures. The experiments were conducted simultaneously, the counts being taken in rapid succession in the two barriers. The same plan was used in both enclosures.

Treatments.

	Carrier	Sodium arsenite %	Molasses %
1.	Horse dung.	1.2	
2.	Horse dung.	1.2	3.6
3.	Kraal dung.	1.2	
4.	Kraal dung.	1.2	3.6
5.	Wheaten bran.	0.6	—
6.	Wheaten bran.	0.6	1.8
7.	Control:	square filled with sand.	

The percentages above are given in terms of pounds per 100 lbs. dry bait. Sufficient river water was added to ensure that all baits had more or less the same moisture content. Horse dung was picked up from the veld in a dry condition, the lumps were broken up and the material was sifted. Kraal manure was collected from sheep and goat kraals.

The figures in table 3 below represent the total number of hoppers counted on the various treatments. Two readings were taken in each enclosure, and the four figures were added together to arrive at those presented in the table. The air temperature ranged between 78° F and 84° F. while the readings were taken.

Table 3: The total number of hoppers counted on each treatment in experiment No. 3.

Treatment no.	1	2	3	4	5	6	7	Total
A	145	101	28	8	260	210	9	761
B	68	59	9	36	220	350	5	747
C	123	105	2	7	274	208	17	736
D	100	45	33	9	137	159	4	487
Total	436	310	72	60	891	927	35	2731 (G.T.)
Average	109	77.5	18	15	222.8	231.8	8.8	

Table 3a: Interaction table.

	Horse dung.	Kraal dung.	Wheaten bran.	Total.
Without molasses	436	72	891	1399
With molasses	310	60	927	1297
Total	746	132	1818	2696 (Grand total.)

Table 3b: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square ÷ 100	$\frac{1}{2} \log e$ mean square ÷ 100	z	z at P — 0.05
Blocks	3	7343	24.476	1.5989	0.2773	0.5753
Carriers. . . .						
vs. control .	1	43142.9	431.43	3.0336	1.7120	0.7424
Carriers. . . .	2	182032.4	910.16	3.4068	2.0852	0.6341
Sweetening .	1	433.7	4.337	.7336	—	0.7424
Interaction .	2	1730.8	8.654	1.0789	—	0.6341
Error.	18	25306.17	14.06	1.3216		
Total	27	259988.97				

Conclusions:

(1) More hoppers visited the treated plots than the untreated plots, i. e. the baits offered were not repellent as compared with the control plots.

(2) There is no difference between baits containing molasses and baits containing no molasses. Mortality tests carried out by the junior author in this locality in enclosures corroborate this finding. The results of these mortality tests will be published in the near future.

(3) There is a significant difference between the various bait carriers.

Table 3c: Analysis table.

	Wheaten bran	Horse dung.	Kraal dung	Significant difference
Average number of hoppers per treatment ...	227.3	92.8	16.5	76.2

According to the above table

(a) Wheaten bran is significantly better than the other two carriers.

(b) Horse dung is significantly better than kraal dung. This same order of preference was also indicated by mortality tests carried out by the junior author.

(4) There is no interaction between the different carriers and molasses, i. e. the addition of molasses did not have a different effect on and did not add to the attractiveness of the different carriers.

Amount of bait consumed.

In order to correlate the apparent attractiveness or palatability of a bait, as judged by the numbers of hoppers visiting it, with the amount of the bait consumed, estimates of the various quantities consumed were made on the plots after the conclusion of the experiments.

The figures presented in table 3d below represent the estimates arrived at after examination of the residues remaining in both enclosures at the conclusion of the experiment. The percentages estimated in the two enclosures were added and averaged to arrive at the figures in table 3d.

Table 3d: Percentage of bait consumed in each treatment in experiment No. 3.

Treatments	1	2	3	4	5	6	7	Total
A	17	13	0	0	94	94	0	218
B	8	8	0	0	80	99	0	195
C	15	9	0	0	80	93	0	197
D	8	4	0	0	98	98	0	208
Total	48	34	0	0	352	384	0	818
Average	12	8.5	0	0	88	96	0	

Table 3e: Interaction table.

	Horse dung	Kraal dung	Wheaten bran	Total
Without molasses	48	0	352	400
With molasses	34	0	384	418
Total	82	0	736	818
Average	10.2	0	92	

Table 3f: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square	z	z at P = 0.05
Blocks.	3	48.7	16.2	1.3925	—	—
Carriers.	1	0	0	0	0	—
vs. control (2	40672.4	20336.2	5.3070	2.6647	0.6341
Sweetening .	1	13.6	13.6	1.3049	—	—
Interaction						
sweetening						
and carrier .	2	139.0	69.5	1.3634	—	0.6341
Error.	18	4331.0	240.6	2.7423		
Total.	27	45204.7				

From table 3f the following conclusions can be drawn: —

(a) There is a significant difference between the amounts of the different carriers consumed.

(b) Molasses did not add to the attractiveness of the different carriers.

(c) Molasses did not react differently on the different carriers.

The last line of table 3e contains the average percentage of the different baits consumed in experiment No. 3. A difference of 15.8 % between any two of these figures is significant. We may therefore conclude that wheaten bran was significantly better than the other two carriers, and horse dung was not significantly better than kraal dung. As far as could be seen the kraal dung baits remained untouched by the hoppers and only small quantities of the horse dung baits were consumed.

The same general conclusion was arrived at in both cases; the number of hoppers visiting the bait is therefore positively correlated with the estimated amount of bait consumed.

Experiment No. 4 (3rd instar; date 16/3/35).

The following baits were tested: —

	Carrier	Sodium arsenite %	Attractant
1.	Horse dung.	1.2	—
2.	Horse dung.	1.2	3.6 % molasses
3.	Wheaten bran.	0.6	—
4.	Wheaten bran.	0.6	1.8 % molasses.
5.	Horse dung.	5	Mobiloil AA, 4 gallons per 100 lbs. of dung.
6.	Kraal dung.	1.2	3.6 % molasses.
7.	Control:	no treatment.	

The percentages are in terms of pounds per 100 lbs. dry weight of carrier. All the baits except No. 5 were moistened with river water, sufficient water being added to ensure that all the baits would have approximately the same moisture content.

Bait No. 5 was included in order to determine whether oil could be used in baits for hoppers of the brown locust. Parker, Shotwell and Morton (1934) reported that oil could be used in baits for American grasshoppers, and that oil baits had the advantage of remaining moist for longer periods than water baits. Their formula was bran 100 lbs. white arsenic 5 lbs. and oil 2 gallons. We used an equal volume of dry horse dung instead of the bran; the amount of oil was doubled because the dung bait appeared to be too dry with only 2 gallons per 100 lbs. of carrier; and instead of white arsenic an equal weight of sodium arsenite was taken.

The plan of randomization was the same as for experiment No. 3.

Table 4: Number of hoppers counted on each treatment at 9 a.m. in experiment No. 4. (Temperature 71° F.; relative humidity 60 %).

Treatment No.	1	2	3	4	5	6	7	Total
A	100	20	200	70	10	40	2	442
B	110	10	70	60	7	4	0	261
C	150	120	10	26	9	7	3	325
D	160	10	100	120	3	10	0	403
Total	520	160	380	276	29	61	5	1431
Average ...	130	40	95	69	7.2	15.2	1.2	

Table 4a: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square	z	z at P = 0.05
Blocks	3	2797.0	932.3	—	—	—
Treatment .	6	57156.4	9526.1	4.5808	0.8288	0.4894
Error	18	32709.3	1817.1	3.7520		
Total	27	92662.7				

Referring to the averages arrived at in table 4 (significant difference = 63.2 hoppers) the following conclusions can be drawn: —

(1) Horse dung, wheaten bran and wheaten bran plus molasses are significantly more attractive than the control; these baits do not differ significantly from each other in attractiveness.

(2) The following baits did not prove significantly more attractive than the control: — horse dung plus molasses, horse dung plus oil, and kraal dung plus molasses.

(3) Horse dung bait containing no molasses is significantly more attractive than the following baits: — horse dung plus molasses, horse dung plus oil and kraal dung plus molasses.

(4) Wheaten bran bait containing no molasses is significantly more attractive than the following baits: — horse dung plus oil and kraal dung plus molasses.

Due to the fact that only one reading could be taken fairly late in the morning, an attractive carrier like bran did not show up well because most of it had been consumed by the time the count was made. It will, however, be apparent from the amount of bait consumed in the various treatments at the conclusion of the experiment, that the bran bait was much more attractive than the other baits, with the exception of horse dung plus 1.2 % arsenite.

Table 4b: Percentage of bait consumed at conclusion of experiment No. 4.

Treatments	1	2	3	4	5	6	7	Total
A	98	67	100	100	20	5		390
B	40	30	100	100	20	5		295
C	85	100	85	85	5	5		365
D	50	5	67	100	5	2		229
Total	273	202	352	385	50	17	—	1279
Average ...	68.2	50.0	88	96.2	12.5	4.0		

Table 4c: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square	z	z at P = 0.05
Blocks	3	2538.5	844.6	—	—	—
Treatments	5	29402.7	5880.5	4.3397	1.3349	0.5326
Error.	15	6109.8	407.3	3.0048		
Total	23	38051.0				

Referring to the averages arrived at in table 4b, (significant difference 30.3 %) the following conclusions can be drawn: —

(1) A larger percentage of the bran baits was consumed than of all other baits, except horse dung plus 1.2 % sodium arsenite.

(2) Oil appears to be a deterrent in horse dung bait.

(3) Very little of the kraal manure bait was consumed, even though it contained molasses.

It is again evident that the number of hoppers visiting a certain bait is directly correlated with the amount of the bait consumed.

Experiment No. 5 (3rd instar; date 16/3/35).

The following baits were compared: —

	Carrier	Sodium arsenite %	Attractant
1.	Wheaten bran.	0.6	1.8 % molasses.
2.	Horse dung.	1	16 % salt (Na Cl)
3.	Horse dung.	1	16 % sodium acid phosphate
4.	Kraal dung.	1	16 % salt (Na Cl)
5.	Kraal dung.	1	16 % sodium acid phosphate.
6.	Horse dung.	1	16 % calcium phosphate.
7.	Control:	no treatment	

The plan of randomization was the same as for experiments 3 and 4.

Table 5: Number of hoppers counted on each treatment at 9.20 a.m. in experiment No. 5. (Temperature 75° F.; relative humidity 55 %).

Treatment No.	1	2	3	4	5	6	7	Total
A	200	70	82	70	150	50	5	627
B	200	60	48	9	20	100	10	447
C	200	200	180	120	60	5	16	781
D	200	0	120	0	20	15	5	360
Total	800	330	430	199	250	170	36	2215
Average ...	200	82.25	107.5	49.75	62.5	42.5	9	

Table 5a: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square	z	z at P = 0.05
Blocks	3	15134.7	5044.9	—	—	—
Treatments	6	91301.9	15216.9	4.8152	0.9363	0.4894
Error	18	42106.1	2339.2	3.8789		
Total	27	148542.7				

Referring to the averages arrived at in table 5 (significant differences = 72) the following conclusions can be drawn: —

(1) Bran bait was significantly more attractive than any other bait.

(2) There is no difference between the other baits in attractiveness, but there is an indication that sodium acid phosphate added to the attractiveness of horse dung.

Table 5b: Percentage of bait consumed at conclusion of experiment No. 5.

Treatments	1	2	3	4	5	6	7	Total
A	100	15	70	15	40	35	0	275
B	100	40	50	10	5	40	0	245
C	100	40	55	15	20	15	0	245
D	100	10	98	30	5	30	0	273
Total	400	105	273	70	70	120	0	1038
Average ...	100	26	68	17	17	30	0	

Table 5c: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ mean square	z	z at P = 0.05
Blocks	3	140.6	46.8	—	—	—
Treatments	5	22545.0	4509.0	4.2071	1.4702	0.5326
Error	15	3425.0	228.3	2.7369		
Total	23	26110.6				

From the averages arrived at in table 5b the following conclusions can be drawn (significant difference 23): —

(1) A larger amount of the bran bait was consumed than of any other bait.

(2) More of the horse dung plus sodium acid phosphate was eaten than of the horse dung baits containing calcium phosphate or salt.

(3) The kraal dung baits were taken in much smaller quantities than bran or horse dung plus sodium acid phosphate; kraal dung plus salt was no more attractive than kraal dung plus sodium acid phosphate.

Comparing the conclusions drawn from the results in tables 5 and 5b, it is once more evident that the amount of any bait consumed is directly proportional to the number of hoppers counted on it.

GENERAL CONCLUSIONS.

With regard to the poisons sodium arsenite, barium fluosilicate and sodium fluoride, it is evident that they are not palatable or attractive to brown locust hoppers. Sodium arsenite just attained the significance level above the control in the first experiment, but not in the second experiment. In view of the results of these two experiments, one feels entitled to state that the poisons, and especially sodium arsenite, are not strongly repellent to the hoppers since some hoppers at least visited the plots containing these powders.

The conclusion arrived at by Faure (1935), to the effect that arsenite of soda serves to attract hoppers of the brown locust, was not confirmed by our experiments. We did, however, note, that some hoppers visited the plots containing arsenite of soda. Therefore our observations partly confirmed the general impression of Faure and the locust officers referred to in his paper, that hoppers will stop on strips of arsenite dusted across their line of march. We also found that sodium chloride was more attractive than arsenite of soda, instead of less attractive.

As for the potential taste improvers sugar, salt and sodium acid phosphate, it appears that all three are more attractive than the control. Sugar must be considered as the least attractive of the three substances. In the second experiment salt and sodium acid phosphate proved to be significantly more attractive than the three poisons tested.

The question now naturally arises whether salt, sugar or sodium acid phosphate added to poison baits will render the baits more attractive to hoppers than baits without these potential attractants. The effect of the addition of salt and sodium acid phosphate to baits was not studied in mortality tests. But the experiments described in this paper seem to indicate that sodium acid phosphate adds to the attractiveness of horse dung baits.

With regard to the three carriers, the results showed clearly that wheaten bran is much more attractive than either horse dung or kraal dung, and that horse dung is more attractive than kraal dung. The sweetening agent, molasses, did not render any of the baits more attractive. Sodium arsenite was used throughout as the poisonous ingredient in the baits.

The addition of oil did not add to the attractiveness of horse dung baits; on the contrary, the oil seemed to act as a repellent.

The results of these experiments showed that valuable indications with regard to the attractiveness of various chemicals, carriers and poison baits can be obtained by observing the number of hoppers which visit, and remain for some time in, plots containing the different treatments. The method of experimentation described makes it possible to perform a large number of tests in a very short time,

and this is a factor of considerable importance. The experiments showed that the amount of a material consumed is directly proportional to the number of hoppers observed to visit it.

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A new genus and four apparently new species of Coccidae (Homoptera) from the Union of South Africa *)

by

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OCTOCOCCUS GEN. NOV.

Pseudococcine forms in which the adult female becomes enclosed in a closely felted sac. Anal ring of the adult female with eight setæ of which six are situated normally and two just beyond the anal ring of pores at the posterior extremity of the anal orifice. Anal lobes small but conspicuous. Cerarii confined to the anal and penultimate segments. Posterior abdominal segments with or without transverse rows of stout conical spines. Antennæ of 8 or 9 segments. Tarsal claws without a denticle. Dermal pores of the types normally found in Pseudococcine forms.

Type of the genus — *Octococcus pentziæ* sp. n.

The genus *Octococcus* resembles *Puto* in possessing 9 segmented antennæ and eight setæ on the anal ring, but unlike that genus the cerarii are confined to the anal and penultimate segments, and there is no denticle on the tarsal claw. The species described by Brain under the name of *Puto(?) africanus* (The Coccidæ of South Africa., Trans. Roy. Soc. S. Africa, Vol. V., Part, 2, p. 151, 1915) is also assigned to the genus *Octococcus*. Four paratype slides of this species have been available for study through the kindness of Mr. H. K. Munro of the Department of Agriculture, Pretoria.

***Octococcus pentziæ* sp. n. (Figure 1).**

Adult female enclosed in a closely felted sac which is white or more often dirty white on account of extraneous matter which has become incorporated. The sac is broadly ovoid and convex, almost globular, with a small orifice towards one extremity.

Dead adult females smoky black or very dark purple, shrivelled and very small—rarely exceeding 1 mm. in length. The dermis

*) The writer is indebted to Mr. H. K. Munro of the Entomological Section of the Division of Plant Industry at Pretoria for the material of the four interesting species dealt with in this short paper. This opportunity is also taken of gratefully acknowledging the assistance rendered by Dr. T. J. Naudé, Chief Entomologist, and Mr. Munro in loaning slides and material from time to time.

appears to be devoid of secretory covering and no lateral or caudal filaments are apparent.

The adult female when mounted for microscopical examination is oval in outline, small and often somewhat shrivelled and rarely exceeds 1.5 mm. in length and 1.0 mm. in breadth. The antennæ consist of nine segments the lengths of which are relatively constant; the 1st., 2nd., 7th., 8th., and 9th. are much the same length and longer than the 3rd., 4th., 5th. and 6th. which are also subequal although there is a tendency for the 6th. to be the shortest and the 3rd. the longest of these. In one or two out of some 80 antennæ examined the division between the 4th. and 5th. was incomplete. The number, nature and arrangement of the setæ on the various segments normal.

The mid and hind limbs are characterised by a few unusually stout, almost conical, spines that occur on the coxa, trochanter and femur, otherwise they are normal with the tarsus of the hind limb slightly more than half the length of the tibia and the tibia a little longer than the femur. There is no denticle on the claw.

The anal ring has eight setæ; there is the usual ring of pores in which six setæ are situated but the anal orifice is prolonged somewhat beyond the ring of pores which is broken posteriorly and two further setæ occur one on either side at the termination of this prolongation.

Caudal lobes small but conspicuous, each carrying a stout seta about $174\ \mu$ in length (the anal setæ are about $110\ \mu$ in length) and four or five shorter stout setæ of varying lengths. Cerarii confined to the anal and penultimate segments, the anal pair consist of two stout spines and four or five small trilocular pores whilst those on the penultimate segments have two rather smaller spines and three or four trilocular pores. The cerarian spines are slightly but distinctly constricted at the base.

Dorsal dermis with numerous stout setæ, those on the posterior abdominal segments are the longest and stoutest. Ventral dermis almost devoid of setæ but with a few scattered large disk pores. All setæ are slightly blunted at their extremities and do not terminate in the usual very fine and slender point. Pores on the dorsal dermis not very numerous and consisting of the small trilocular type and two size of pore with definite subcateneous tubes, the smaller of these is slightly larger than the trilocular pores whilst the larger are smaller than the circular disk pores of the ventral dermis.

On *Pentzia* sp. (Compositæ), Grootfontein School of Agriculture, Middelburg, Cape, November, 1935.

It is quite clear that *O. pentziæ* and the species described as *Puto* (?) *africanus* by Brain (*l.c.*) are congeneric. Brain included his species tentatively in the genus *Puto* on the grounds that it had

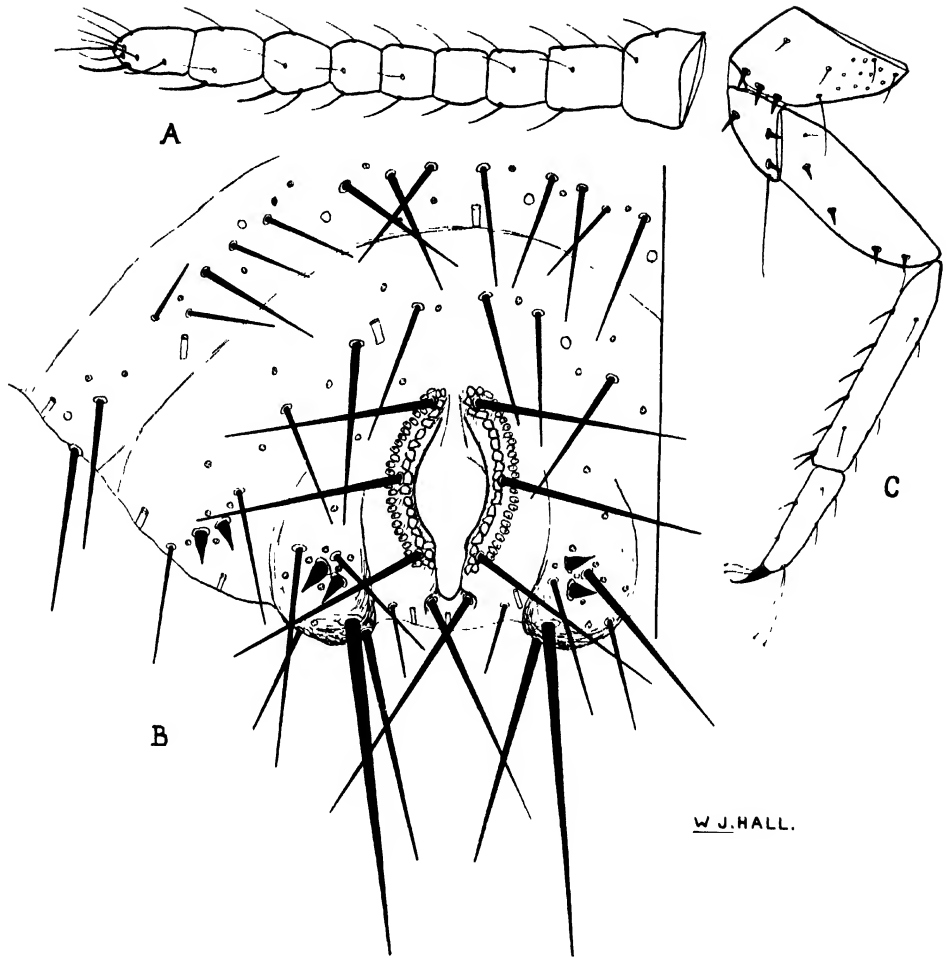


Fig. 1. — *Octococcus pentzia* sp. n.: Adult ♀. A, antenna, x 114; B, dorsal aspect of posterior extremity of abdomen, x 114; C, hind limb, x 170.

9-segmented antennæ and eight hairs on the anal ring. Ferris (The Californian Species of Mealy Bugs, 1918, p. 61) states „It may be noted that Brain has quite misunderstood this genus (*Puto*) and has placed it among the Eriococcine forms solely because of the 8-haired anal ring. The species which he has described as *P. africanus* undoubtedly does not belong to this genus.” It is the view of the writer that not only can *africanus* not be placed in the genus *Puto* but that there is apparently no genus in which it can be satisfactorily

placed. For this reason the new genus *Octococcus* has been erected to include both *pentziæ* and *africanus*.

Pentziæ differs from *africanus* chiefly in the absence of the conical spines on the posterior abdominal segments, but in other respects the two species bear a remarkable similarity and both exhibit the same unusual characteristics.

Considerable difficulty was experienced in securing satisfactorily cleared mounts of this species, although several methods were tried. The limbs are extremely fragile and although the setæ are so stout they are apparently delicate, for they are so frequently broken or bent. This is particularly true of the very stout caudal setæ which were only intact in four or five instances, and then bent in one or more places. In all the above respects *africanus* seems to be similar to *pentziæ*.

Other unusual features shared by both *pentziæ* and *africanus* are the conical spines on the coxæ, trochanters and femora of the mid and hind limbs and the slight but distinct constriction at the base of the cerarian spines. Incidentally Brain does not refer to either of the above characteristics in his description of *africanus*.

***Pseudococcus barleria* sp. n. (Figure 2).**

Adult female small and rarely exceeding 1.5 mm. in length, oval in shape, pale brown in colour and very sparsely coated with white pulverulent matter. No marginal or caudal filaments apparent. Eggs yellow and in some individuals they were observed to emerge joined together like a string of sausages.

Antennæ of the adult female relatively short, consisting normally of seven segments, the relative lengths of which are more or less constant. The only variation of importance occurs in the 4th. segment which often exhibits incomplete division, and in a few individuals complete division, giving an 8-segmented antenna. In the normal 7-segmented form the terminal segment is much the longest with the 2nd. next longest; the 1st. is only slightly shorter than the 2nd.; the 4th. and 6th. are subequal and shorter than the 1st., whilst the 5th. is the shortest with the 3rd. only slightly longer.

Limbs relatively small but normal in every way, with the exception of the hind coxæ, which are very much enlarged, whereas those of the mid and fore limbs are in the usual proportion to the remainder of the limbs. The forelimbs are about $\frac{4}{7}$ the length of the hindlimbs but their coxæ are only about $\frac{1}{2}$ the size of those found in the latter pair. Tarsal digitules not knobbed. Anterior and posterior osteoles present but very inconspicuous.

Caudal setæ about 130 μ in length; anal setæ relatively short being only slightly more than half the length of the caudal pair. Anal ring of normal form. Ceriferous tracts confined to a single

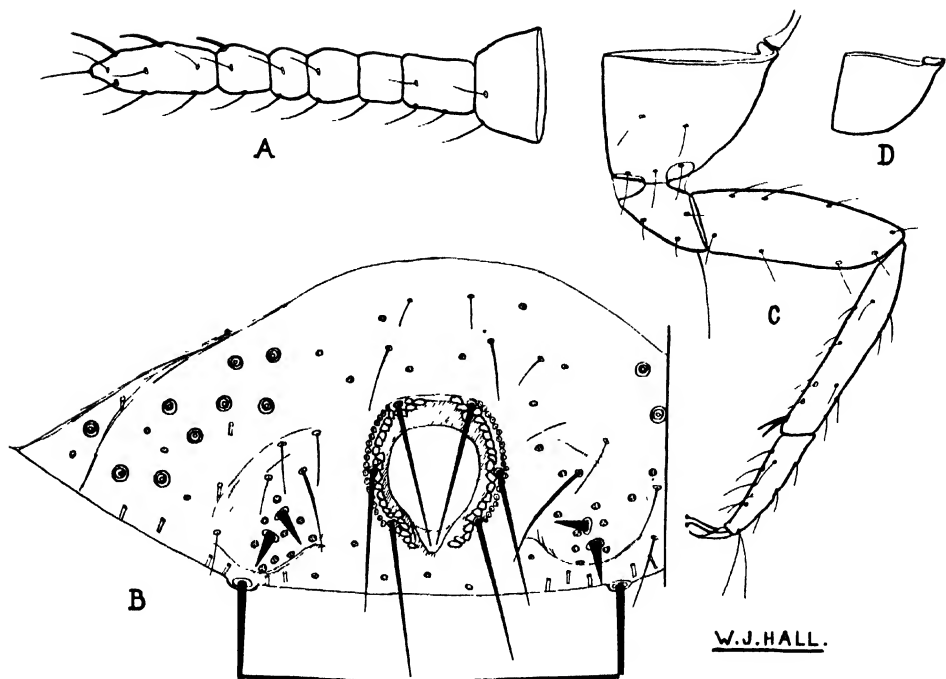


Fig. 2. - *Pseudococcus barleriae* sp. n. : Adult ♀. A, antenna, x 114; B, dorsal aspect of posterior extremity of abdomen, x 114; C, hind limb, x 170; D, coxa of fore limb, x 170.

pair on the anal segment; these tracts consist of two medium sized spines surrounded by a loose group of minute trilocular pores some 8 or 9 in number. A few setae of varying lengths are also associated with each tract.

Dermis with the usual trilocular pores and large circular discoid pores; the former are more numerous on the dorsal and the latter on the ventral dermis but in neither case can they be said to be very numerous. In addition there are scattered pores, similar in size to the trilocular form, with small but conspicuous subcutaneous tubes. A few setae occur on both the ventral and dorsal dermis.

On *Barleria macrostegia* (Acanthaceæ), Pretoria, 1.1.36, in the curled leaves at the end of the twigs, coll. H. K. Munro, Dept. of Agric. Pretoria, No. 4221.

This small species is certainly distinct from any of those recorded or described by Brain from South Africa, and its characters do not appear to agree with those of any species known to the writer. In some respects *barleriae* resembles *Pseudococcus socialis* Brain, but

it differs from this species in the nature of the hind coxæ and the fact that no ovisac is formed. The nature of the hind coxæ, antennæ and ceriferous tracts should be sufficient to distinguish it from other closely allied species. It has been assigned to the genus *Pseudococcus* rather than *Ripersia* because of its tendency towards 8-segmented antennæ, but in other respects it suggests the latter genus.

***Saissetia monotes* var. *pretoriae* var. n.**

This variety differs from typical *Saissetia monotes* Hall (Stylops, Vol. IV, p. 78, 1935) in the following respects: —

1. The thickenings of the dermis in the young adult female are not so conspicuous and do not show the same regular arrangement that is found in typical *monotes*.

2. The ungual digitules are of similar form, both being stout and conspicuously knobbed at the distal extremity.

3. The lateral spines in the stigmatic cleft are relatively shorter, being about $\frac{1}{4}$ to $\frac{1}{5}$ the length of the median spine, and usually only about $\frac{1}{2}$ to $\frac{2}{3}$ that of the marginal setæ.

On *Ficus* sp. (Moraceæ), Pretoria, October, 1938, coll. de Ville.

This material is obviously very close to *monotes* from which it differs chiefly in the nature of the stigmatic spines and the fact that the two ungual digitules to the claw of the limbs are not of different forms as in the case of *monotes*. Both *monotes* and its variety *pretoriae* exhibit an unusually thick and leathery dermis which renders it difficult to get satisfactory preparations for microscopic examination in fact young adult females gave the only preparations of any value.

***Selenaspidus portulacariæ* sp. n. (Figure 3).**

Puparium of the adult female circular, low convex, semitransparent, and pale smoky brown in colour. Larval exuviae golden, nymphal exuviae pale brown to golden. In some specimens the larval exuviae pale brown to golden. In some specimens the larval exuviae exhibit a dark median longitudinal stripe. Diameter of puparium of the adult female, 1.5 mm.

Adult female very nearly as broad as long, with a deep and conspicuous articulation between the cephalothorax and the abdomen. Posterior lateral margin of the cephalothorax broadly rounded with a small tubercle of varying form, which is usually rounded and broader than it is long but may be pointed or even beak shaped. Antennæ represented by a minute tubercle carrying a fine curved seta. Parastigmatic glands wanting. Integument highly chitinated in old individuals. Abdominal segmentation distinct; margin of abdominal segments with a few minute tubular spinnerets.

Pygidium broader than it is long, with three pairs of lobes;

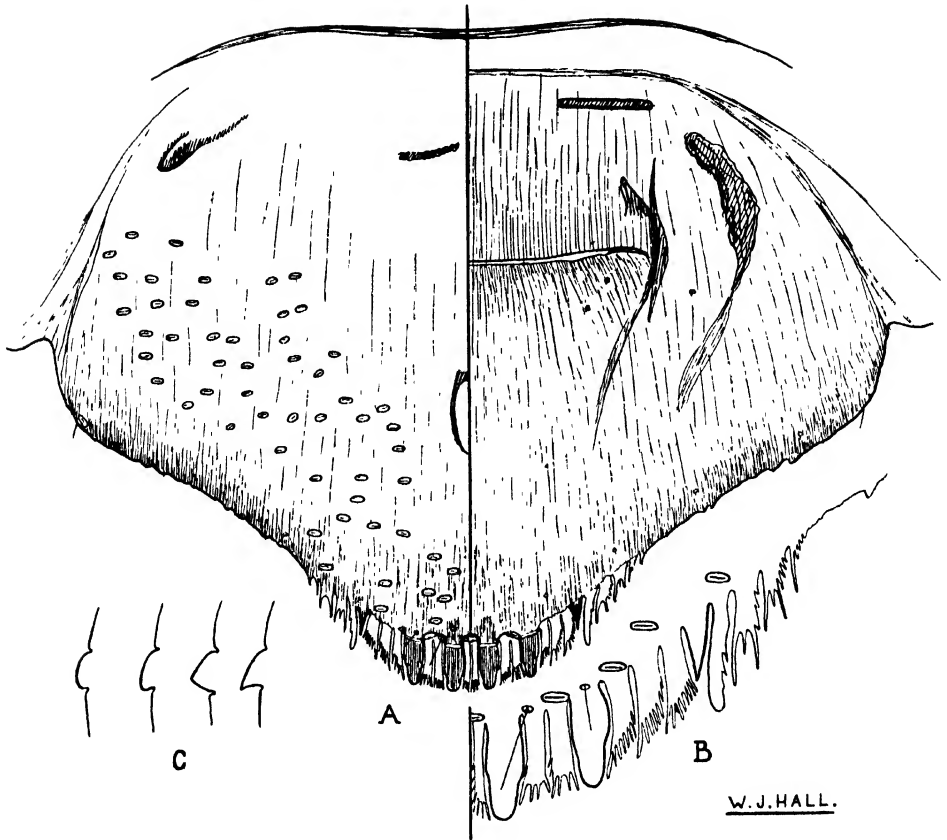


Fig. 3. — *Selenaspidus portulacariae* sp. n.: Adult ♀. A, pygidium, $\times 228$; B, portion of pygidial fringe, $\times 456$; C, various forms of the cephalothoracic tubercle.

median pair twice as long as broad, rounded at the apex and very slightly swollen in the basal half, with the terminal portion somewhat narrowed; first lateral lobes of the same form as the median pair but very slightly smaller and rather more swollen in the basal half; second lateral lobes represented by tusk-like processes. The squamæ are delicately fringed at their distal extremities, one pair occurs between the median lobes, another pair between the median and first lateral lobes, three between the 1st. and 2nd. lateral lobes and four beyond the 2nd. lateral lobes. The nature of the squamæ beyond the 2nd. lateral lobes is somewhat different from the others (Fig. 3b.). Circumgenital glands wanting. Anal orifice situated rather closer to the apex than the base of the pygidium. Vaginal

orifice broad and conspicuous. Dorsal pores with long tubular spinnerets, moderately numerous but without any apparent definite arrangement.

On *Portulacaria afra* (Portulacaceæ), Fort Beaufort, Cape Province, coll. E. E. Anderssen, April 1938.

This species apparently comes close to *S. articulatus* Morgan, from which it differs principally in the absence of circumgenital glands, and the much longer and narrower from of the pygidial lobes.

A preliminary list of the insect pests of crops and fruit trees in Portuguese East Africa

by

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PART I: SYSTEMATIC LIST.

In part I the species are listed under their families and orders. The known foodplants, the nature of the damage done, and the geographical distribution are noted for each species. The geographical distribution is usually indicated by reference to administrative districts.

Orthoptera

Acridiidae

- 1 — *Nomadacris septemfasciata* Serville — Practically all crops. Destruction by chewing of all parts growing above ground. The whole Territory during the outbreak periods.
- 2 — *Locusta migratoria migratorioides* R. et F. — Idem. Idem. The northern part during the outbreak periods.
- 3 — *Locustana pardalina* Wlk. — Idem. Idem. L. Marques during some of the former outbreak periods.
- 4 — *Zonocerus elegans* Thunb. — Idem. Idem. L. Marques and Inhambane.
- 5 — *Catantops melanosticus* Schaum. — Herbaceous plants. Chewing of leaves and twigs. L. Marques.

Isoptera

Metatermitidae

- 6 — *Termes latericius* Hav. — Cotton, citrus, deciduous fruit trees, some forest trees, etc. Chewing and tunnelling of the stem and roots. L. Marques.

Hemiptera-Heteroptera

Pentatomidae

- 7 — *Agonoscelis versicolor* F. — Cotton. Sucking the sap of flowers and buds. L. Marques.

- 8 — *Bagrada hilaris* Burm. — Cruciferous plants and cotton. Killing the cruciferous plants and the cotton buds, by sucking the sap. L. Marques and Inhambane.

Scutelleridæ

- 9 — *Callidea bohemani* Stahl. — Cotton. Sucking the sap from leaves. L. Marques.
10 — *Steganocerus multipunctatus* var. *argus* Fabr. — Idem.

Coreidæ

- 11 — *Anoplocnemis curvipes* Fabr. — Citrus and cotton. Sucking the sap from buds, resulting in their wilting. L. Marques and Inhambane.
12 — *Leptoglossus membranaceus* Fabr. — Citrus, cotton, pea, etc. Premature fall of citrus fruits and wilting of the buds of other foodplants, as a result of sucking the sap. L. Marques, Inhambane and Quelimane.

Lygæidæ

- 13 — *Oxycarenus* spp. — Cotton. Sucking the sap from seeds in open dry bolls, so reducing their germinative power and spotting the fibre. The whole Territory.

Pyrrhocoridæ

- 14 — *Dysdercus nigrofasciatus* Stal. — Cotton, orange and mandarine trees. Cotton: sucking the sap from seeds through the walls of green capsules, causing the spotting of fibre and the drop of green bolls, and allowing of the entrance of germs of internal diseases. Orange trees: sucking the sap from leaves, which become chlorotic and fall off. Mandarin trees: sucking the sap from ripe fruits. The whole Territory.
15 — *Dysdercus intermedius* Dist. — Idem.
16 — *Dysdercus fasciatus* Sign. — Idem.
17 — *Scanthius forsteri* — Cotton. Sucking the sap from buds. L. Marques.

Hemiptera-Homoptera

Aphididæ

- 18 — *Aphis tavaresi* Del Guercio — Citrus. Sucking the sap from buds, which become distorted, shrunken and dry. The whole Territory.

Coccidæ

- 19 — *Icerya purchasi* Mask — Citrus, etc. Sucking the sap from branches and young stems, resulting in the general weakening of plants and, indirectly, their covering by the sooty mould fungus. The whole Territory.
- 20 — *Pseudococcus calceolariae* Mask. — Sugar cane. Sucking the sap from roots, causing the general weakening of plants. L. Marques and Inhambane.
- 21 — *Pseudococcus citri* Risso — Citrus, cotton, etc. Sucking the sap from branches, hence general weakening of plants. L. Marques.
- 22 — *Pseudococcus sacchari* Ckll. — Sugar cane. Sucking the sap from stems, hence general weakening of plants. L. Marques and Inhambane.
- 23 — *Pseudococcus virgatus* Ckll. — Custard apple, cotton, etc. Sucking the sap from branches of all foodplants and from fruits of custard apple, resulting in the general weakening of plants and the depreciation of custard apple fruits. L. Marques and Inhambane.
- 24 — *Pulvinaria jacksoni* Newst. — Cotton. Sucking the sap from branches. L. Marques and Inhambane.
- 25 — *Lepidosaphes pinniformis* Bouché — Citrus. Sucking the sap from twigs, leaves and fruit, spoiling appearance of fruit and causing the general weakening of plants. The whole Territory.
- 26 — *Aonidiella aurantii* Mask. — Citrus. As in previous species but sometimes the plants are killed. The whole Territory.
- 27 — *Chrysomphalus ficus* Ashm. — Citrus, coconut, etc. General weakening of citrus and spoiling appearance of citrus fruits; sucking the sap from old or unhealthy coconut leaves. The whole Territory.

Lepidoptera

Gelechiidæ

- 28 — *Platyedra gossypiella* Saunders — Cotton. Destruction of anthers and developing seeds, and cutting of fibre, which cause shedding of flower buds and young bolls, and a complete or partial lack of dehiscence of the more developed bolls. Pôrto Amélia, Moçambique and Quelimane.
- 29 — *Sitotroga cerealella* Oliv. — Rice, maize and other grains. Feeding on, and destruction of grains. The whole Territory.

Cosmopterigidæ

- 30 — *Anatrachyntis coriacea* Snell. — Cotton. Chewing of leaves and capsule walls. Quelimane.

Eucosmidæ

- 31 — *Argyroploce leucotreta* Meyr. — Orange. Internal tunnelling in the fruits, resulting in their dropping and destruction. L. Marques.

Pyralidæ

- 32 — *Corcyra cephalonica* Stt. — Cotton. Damage to stored seeds. L. Marques.
33 — *Getulia semifuscella* Rag. — Custard apple. Perforation of, and internal tunnelling in the fruits, resulting in their premature fall and destruction. L. Marques.
34 — *Sylepta derogata* Fabr. — Cotton. Chewing and rolling of leaves. L. Marques.

Papilionidæ

- 35 — *Papilio demoleus* L. — Citrus. Chewing of leaves and buds. L. Marques and Inhambane.

Sphingidæ

- 36 — *Herse convolvuli* L. — Sweet potato. Chewing of leaves. L. Marques.
37 — *Hippotion celerio* L. — Tobacco and sweet potato. Idem. Idem.

Saturniidæ

- 38 — *Argema mimosæ* Boisd. — Kapok. Chewing of leaves. L. Marques.
39 — *Nudaurelia belina* Westw. — Idem.
40 — *Cirina similis* Dist. — Idem.
41 — *Heniocha terpsichore* Westw. — Idem.

Noctuidæ

- 42 — *Chloridea obsoleta* Fabr. — Cotton, maize, tobacco, tomato, citrus, etc. Cotton: perforation and destruction of green bolls. Maize: chewing and destruction of female flowers and ears. Tobacco: chewing of buds and fruits. Tomato and citrus: perforation, internal tunnelling and destruction of fruits. The whole Territory.
43 — *Euxoa spinifera* Hübn. — Maize, tobacco, cotton, etc. Cutting off the young plants on the soil level. L. Marques.
44 — *Laphygma exempta* Wlk. — Maize and other cereals. Chewing of leaves. L. Marques and Inhambane.
45 — *Laphygma exigua* Hübn. — Maize, tobacco, cotton, groundnut, etc. Chewing of leaves. L. Marques and Inhambane.
46 — *Diparopsis castanea* Hampsn. — Cotton. Perforation and hollowing out of green bolls. The whole Territory.

- 47 — *Prodenia litura* Fabr. — Cotton, tobacco, maize, castor oil plant, etc. Chewing of leaves. L. Marques and Inhambane.
 48 — *Busseola fusca* Hampsn. — Maize. Perforation of, and tunnelling in the stem, so killing the plants. L. Marques.
 49 — *Sesamia calamistis* Hampsn. — Idem.
 50 — *Earias insulana* Boisd. — Cotton. Perforation and internal destruction of flower buds and green bolls, resulting in shedding and destruction. The whole Territory.
 51 — *Acontia grællsi* Feisth. — Cotton. Chewing of tender leaves. The whole Territory.
 52 — *Phytometra acuta* Wlk. — Mint. Chewing of leaves. L. Marques.
 53 — *Phytometra limbirena* Guen. — Idem.

Coleoptera

Temnochilidæ

- 54 — *Tenebrioides mauritanicus* L. — Cotton, maize and other grains. Feeding on stored seeds. The whole Territory.

Cucujidæ

- 55 — *Oryzaphilus surinamensis* L. — Coconut, cotton, maize, etc. Feeding on „copra”, stored grains, flour, etc. The whole Territory.

Coccinellidæ

- 56 — *Epilachna chrysomelina* Fabr. — Cotton, potato and tomato. Chewing of the parenchyma of leaves, the veins remaining untouched, so giving the leaves a characteristic net-like appearance. L. Marques.
 57 — *Epilachna dregei* Muls. — Potato and tomato. Idem. Idem.
 58 — *Epilachna hirta* Thunb. — Idem.
 59 — *Epilachna paykulli* Muls. — Idem.

Dermestidæ

- 60 — *Dermestes vulpinus* Fabr. — Tobacco. Damage to stored baled tobacco. L. Marques.

Cleridæ

- 61 — *Necrobia rufipes* Geer. — Coconut. Chewing of stored „copra”. Quelimane.

Anobiidæ

- 62 — *Sitodrepa panicea* L. — Cereals, etc. Infestation of seeds, flour, etc. The whole Territory.

- 63 — *Lasioderma serricorne* L. — Tobacco, cotton, maize and other cereals, etc. Perforation of cigarettes and cigars in tobacconists' stores, and chewing of stored seeds of other foodplants. The whole Territory.

Bostrichidæ

- 64 — *Enneadesmus forficula* subsp. *capensis* Lesne — Sugar cane. Perforation of stems. L. Marques.

Buprestidæ

- 65 — *Pseudagrilus splendens* L. et G. — Cotton. Perforation of the stem. L. Marques.

Tenebrionidæ

- 66 — *Zophosis* sp. — Tobacco. Chewing of the subterranean portion of the stem of young plants, resulting in their destruction. The whole Territory.
- 67 — *Psammodes coriaceus* Gerst. — Coconut. Chewing of stems of young plants, below and on the soil level. Quelimane.
- 68 — *Psammodes scrobicollis* Fahrs. — Tobacco. Chewing and destruction of stems of young plants, below and on the soil level, resulting in the death of plants. The whole Territory.
- 69 — *Gonocephalum dermestoides* Gerst. — Tobacco. Chewing of the basal part of stems. Quelimane.
- 70 — *Tribolium confusum* Jacq. Duval — Maize and other cereals. Chewing of, and damage to stored seeds. The whole Territory.
- 71 — *Tribolium ferrugineum* Fabr. — Maize, other cereals and cotton. Idem. Idem.

Lagriidæ

- 72 — *Lagria æneipennis* Fahr. — Cotton. Chewing of leaves. L. Marques and Quelimane.
- 73 — *Lagria villosa* Fabr. — Idem.

Meloidæ

- 74 — *Coryna argentata* Fabr. — Cotton. Chewing of flowers and leaves. L. Marques.
- 75 — *Coryna pilosa* Fahr. — Idem.
- 76 — *Coryna marshalli* Pic. — Idem.
- 77 — *Ceroctis phalerata* Ol. — Idem.
- 78 — *Ceroctis trifurca* Gerst. — Idem.
- 79 — *Mylabris bihumero* Mars. — Cotton, beans and other vegetables, citrus. Chewing of flowers, leaves and buds. L. Marques.

- 80 — *Mylabris burmeisteri* Bertol. — Idem.
- 81 — *Mylabris dicincta* Bertol. — Idem.
- 82 — *Mylabris oculata* Thunb. — Idem.
- 83 — *Decapotoma catenata* Gerst. — Cotton. Chewing of flowers and leaves. L. Marques, Inhambane and Quelimane.
- 84 — *Decapotoma lunata* var. *digressa* Pering — Idem.
- 85 — *Actenodia decemguttata* Thunb. — Idem.
- 86 — *Epicauta strangulata* Gerst. — Potato and cotton. Chewing of flowers and leaves. L. Marques.
- 87 — *Epicauta velata* Gerst. — Idem.

Bruchidæ

- 88 — *Bruchus pisorum* L. — Peas and beans. Perforation of green pods, and burrowing in developing seeds, which are practically destroyed. L. Marques.
- 89 — *Bruchus chinensis* Thunb. — Peas, beans, other vegetables and cotton. Burrowing in, and destruction of ripe seeds. The whole Territory.
- 90 — *Bruchus obsoletus* Say. — Idem. Idem. L. Marques.
- 91 — *Bruchus quadrimaculatus* Fabr. — Idem.
- 92 — *Spermophagus sericeus* Geoffr. — Cotton. Burrowing in, and destruction of seeds. L. Marques.

Chrysomelidæ

- 93 — *Colasposoma scutellane* Leef. — Cotton, tobacco and citrus. Chewing of leaves. L. Marques.
- 94 — *Syagrus morio* Has. — Cotton. Idem. Idem.
- 95 — *Syagrus rugifrons* Baly — Idem.
- 96 — *Corynodes dejeani* Berth. — Idem.
- 97 — *Candezea variipennis* Jac. — Idem.

Cassididæ

- 98 — *Aspidomorpha tecta* Boh. — Tomato, potato and other solanaceous plants. Chewing of leaves. L. Marques.
- 99 — *Aspidomorpha apicalis* subsp. *confinis* Klug. — Idem.
- 100 — *Conchyloctenia hybrida* Boh. — Idem.
- 101 — *Conchyloctenia tigrina* Ol. — Idem.
- 102 — *Hypocassida gibipennis* Boh. — Idem.

Cerambycidæ

- 103 — *Phoracantha semipunctata* Fabr. — Eucalyptus. Tunnelling through the bark and surface of wood in dying or dead trees. L. Marques.
- 104 — *Anthores leuconotus* Pasc. — Coffee. Tunnelling through the stem and roots, resulting in the general weakening or death of plants. L. Marques and Inhambane.

- 105 — *Tragiscoschema wahlbergi* Fahr. — Cotton. Tunnelling through the stem and twigs. L. Marques.
 106 — *Apomecyna binubila* Pasc. — French bean. Tunnelling through the twigs, which are killed. L. Marques.
 107 — *Volumnia apicalis* var. *westermanni* Thoms. — Cotton. Tunnelling through the twigs, which die out. L. Marques.

Curculionidæ

- 108 — *Apion consimile* Wagnr. — Cotton. Perforation of branches and stems, mainly on the joints, burrowing in the cortical layer and central cylinder, which causes the death of branches and even plants. Quelimane and Moçambique.
 109 — *Apion considerandum* Fahr. — Idem.
 110 — *Apion constrictum* Hartm. — Idem.
 111 — *Alcides erythropterus* Chev. — Cotton. Ring-barking, perforation and internal chewing of twigs. L. Marques.
 112 — *Cryptorhynchus mangifera* Fabr. — Mango. Feeding on the cotyledons of the seeds, premature fall of fruits, and probably dissemination of anthracnosis among mango trees. L. Marques.
 113 — *Omophorus stomachosus* Boh. — Wild fig. Internal chewing and destruction of fruits, which turn dark and drop. L. Marques.
 114 — *Rhynchophorus phoenicis* Fabr. — Coconut. Perforation of, and tunnelling in the stem, which stops growing and eventually dies. Quelimane.
 115 — *Rhina afzelii* Fhs. — Coconut. Perforation of, and burrowing into the stem, causing the weakening and death of plants. Quelimane.
 116 — *Goniorrhinus hardenbergi* Mshl. — Cotton. Attack on newly germinated plants. L. Marques.
 117 — *Sitophilus oryzae* L. — Maize and other cereals. Chewing of grains. The whole Territory.

Scarabaeidæ

- 118 — *Anomala ustulata* Arr. — Sugar cane. Chewing and destruction of roots. L. Marques.
 119 — *Popillia bipunctata* Fabr. — Cotton. Chewing of flowers. L. Marques and Inhambane.
 120 — *Oryctes boas* Fabr. — Coconut. Perforation of, and burrowing in the stem, resulting in the death of plants. Inhambane and Quelimane.
 121 — *Oryctes gigas* Cast. — Coconut. Perforation of, and burrowing in the stem. Quelimane.

- 122 — *Oryctes monoceros* Ol. — Coconut. Perforation and chewing of, and cutting off the stem. Quelimane.
 123 — *Heteronychus licas* Klug. — Maize and sugar cane. Eating out the soft center of the stalk of young plants, which are killed. The whole Territory.
 124 — *Temnorhynchus antiochus* Fairm. — Coconut. Chewing of, and cutting off the stems. Quelimane.
 125 — *Pachnoda euparypha* Gerst. — Idem.
 126 — *Pachnoda impressa* Goldf. — Cotton. Chewing of flowers and leaves. L. Marques.
 127 — *Pachnoda rufa* Geer. — Idem.
 128 — *Diplognatha gagates* var. *silicea* M'Leay — Idem.

Hymenoptera

Tenthredinidæ

- 129 — *Athalia flacca* Konow. — Turnip, cabbage and other cruciferous plants. Chewing of the leaf parenchyma. L. Marques.

Diptera

Trypetidæ

- 130 — *Dacus ciliatus* Lw. — Melon. Feeding on the internal tissues of fruits, which turn brown and decay. L. Marques.
 131 — *Dacus pectoralis* Walk. — Idem.
 132 — *Dacus vertebratus* Bez. — Idem.
 133 — *Ceratitis capitata* Wd. — Citrus and guava. Feeding on the endocarp, which causes the decay and premature drop of fruits. L. Marques.
 134 — *Ceratitis cosyra* Walk. — Citrus. Idem. Idem.
 135 — *Ceratitis rosa* Ksh. — Citrus and guava. Idem. Idem.

PART II: CROPS LIST.

In this part the insect pests of each of the main crops and fruits are enumerated. The crops and fruits are alphabetically arranged. Some very important crops, such as groundnuts and tea, are not mentioned because they do not seem to be liable to severe insect attacks in P. E. A. Further notes concerning each insect species will be found in part I. The number on the right of each species, in parentheses, corresponds to its number in part I.

Citrus insect pests

Insects which attack the root and stem:

- 1 — *Termes latericius* Hav. (6)

Insects which attack the stem, foliage and fruit:

- 2 — *Lepidosaphes pinnæformis* Bouché (25)
 3 — *Aonidiella aurantii* Mask (26)

Insects which attack the foliage:

- 4 — *Anoplocnemis curvipes* Fabr. (11)
 5 — *Dysdercus nigrofasciatus* Stal. (14)
 6 — *D. intermedius* Dist. (15)
 7 — *D. fasciatus* Sign. (16)
 8 — *Aphis tavaresi* Del Guercio (18)
 9 — *Icerya purchasi* Mask. (19)
 10 — *Pseudococcus citri* Risso (21)
 11 — *Papilio demoleus* L. (35)
 12 — *Colasposoma scutellare* Leef. (93)

Insects which attack the foliage and flower:

- 13 — *Mylabris bihumerosa* Mars. (79)
 14 — *M. burmeisteri* Bertol. (80)
 15 — *M. dicincta* Bertol. (81)
 16 — *M. oculata* Thunb. (82)

Insects which attack the foliage and fruit:

- 17 — *Leptoglossus membranaceus* Fabr. (12)
 18 — *Chrysomphalus ficus* Ashm. (27)

Insects which attack the fruit;

- 19 — *Argyroploce leucotreta* Meyr. (31)
 20 — *Chloridea obsoleta* Fabr. (42)
 21 — *Ceratitis capitata* Wd. (133)
 22 — *C. cosyra* Walk. (134)
 23 — *C. rosa* Ksh. (135)

Coconut insect pests

Insects which attack the stem:

- 1 — *Psammodes coriaceus* Gerst. (67)
 2 — *Rhynchophorus phoenicis* Fabr. (114)
 3 — *Rhina afzelii* Fhs. (115)
 4 — *Oryctes boas* Fabr. (120)
 5 — *O. gigas* Cast. (121)
 6 — *O. monoceros* Ol. (122)
 7 — *Temnorhynchus antiochus* Fairm. (124)
 8 — *Pachnoda euparypha* Gerst. (125)

Insects which attack the „copra”:

- 9 — *Oryzaphilus surinamensis* L. (55)
 10 — *Necrobia rufipes* Geer. (61)

Cotton insect pests

Insects which attack the root and stem:

- 1 — *Termes latericius* Hav. (6)

Insects which attack the stem:

- 2 — *Euxoa spinifera* Hübn. (43)
 3 — *Pseudagrilus splendens* L. et G. (65)
 4 — *Goniorrhinus hardenbergi* Mshl. (116)

Insects which attack the stem and twig:

- 5 — *Tragiscoschema wahlbergi* Fahr. (105)
 6 — *Volumnia apicalis* var. *westermanni* Thoms. (107)
 7 — *Apion consimile* Wagnr. (108)
 8 — *A. considerandum* Fahr. (109)
 9 — *A. constrictum* Hartm. (110)
 10 — *Alcides erythropterus* Chev. (111)

Insects which attack the foliage:

- 11 — *Bagrada hilaris* Burm. (8)
 12 — *Callidea bohemani* Stahl (9)
 13 — *Steganocerus multipunctatus* var. *argus* Fabr. (10)
 14 — *Anoplocnemis curvipes* Fabr. (11)
 15 — *Leptoglossus membranaceus* Fabr. (12)
 16 — *Scanthius forsteri* (17)
 17 — *Pseudococcus citri* Risso (21)
 18 — *P. virgatus* Ckll. (23)
 19 — *Pulvinaria jacksoni* Newst. (24)
 20 — *Anatrachyntis coriacea* Snell. (30)
 21 — *Sylepta derogata* Fabr. (34)
 22 — *Laphygma exigua* Hübn. (45)
 23 — *Prodenia litura* Fabr. (47)
 24 — *Acontia grælli* Feisth (51)
 25 — *Epilachna chrysomelina* Fabr. (56)
 26 — *Lagria æneipennis* Fahr. (72)
 27 — *L. villosa* Fabr. (73)
 28 — *Colasposoma scutellare* Leef. (93)
 29 — *Syagrus morio* Has. (94)
 30 — *S. rugifrons* Baly (95)
 31 — *Corynodes dejeani* Berth. (96)
 32 — *Candezea variipennis* Jac. (97)

Insects which attack the foliage and flower:

- 33 — *Agonoscelis versicolor* Fabr. (7)
 34 — *Coryna argentata* Fabr. (74)
 35 — *C. pilosa* Fahr. (75)

36 —	<i>C. marshalli</i> Pic.	(76)
37 —	<i>Ceroctis phalerata</i> Ol.	(77)
38 —	<i>C. trifurca</i> Gerst.	(78)
39 —	<i>Mylabris bihumerosa</i> Mars.	(79)
40 —	<i>M. burmeisteri</i> Bertol.	(80)
41 —	<i>M. distincta</i> Bertol.	(81)
42 —	<i>M. oculata</i> Thunb.	(82)
43 —	<i>Decapotoma catenata</i> Gerst.	(83)
44 —	<i>D. lunata</i> Pering	(84)
45 —	<i>Actenodia decemguttata</i> Thunb.	(85)
46 —	<i>Epicauta strangulata</i> Gerst.	(86)
47 —	<i>E. velata</i> Gerst.	(87)
48 —	<i>Popillia bipunctata</i> Fabr.	(119)
49 —	<i>Pachnoda impressa</i> Goldf.	(126)
50 —	<i>P. rufa</i> Geer.	(127)
51 —	<i>Diplogntha gagates</i> var. <i>silicea</i> M'Leay	(128)

Insects which attack the floral bud and green boll:

52 —	<i>Platyedra gossypiella</i> Saunders	(28)
53 —	<i>Earias insulana</i> Boisd.	(50)

Insects which attack the green boll:

54 —	<i>Dysdercus nigrofasciatus</i> Stal.	(14)
55 —	<i>D. intermedius</i> Dist.	(15)
56 —	<i>D. fasciatus</i> Sign.	(16)
57 —	<i>Chloridea obsoleta</i> Fabr.	(42)
58 —	<i>Diparopsis castanea</i> Hampsn.	(46)

Insects which attack the dry seed:

59 —	<i>Oxycaenus</i> spp.	(13)
60 —	<i>Corcyra cephalonica</i> Stt.	(32)
61 —	<i>Tenebrioides mauritanicus</i> L.	(54)
62 —	<i>Oryzaphilus surinamensis</i> L.	(55)
63 —	<i>Lasioderma serricorne</i> L.	(63)
64 —	<i>Tribolium ferrugineum</i> Fabr.	(71)
65 —	<i>Bruchus chinensis</i> L.	(89)
66 —	<i>B. obsoletus</i> Say	(90)
67 —	<i>B. quadrimaculatus</i> Fabr.	(91)
68 —	<i>Spermophagus sericeus</i> Geoffr.	(92)

Kapok insect pests

Insects which attack the foliage:

1 —	<i>Argema mimosæ</i> Boisd.	(38)
2 —	<i>Nudaurelia belina</i> Westw.	(39)

- 3 — *Cirina similis* Dist. (40)
 4 — *Heniocha terpsichore* Westw. (41)

Maize insect pests

Insects which attack the stalk:

- 1 — *Euxoa spinifera* Hübn. (43)
 2 — *Busseola fusca* Hampsn. (48)
 3 — *Sesamia calamistis* Hampsn. (49)
 4 — *Heteronychus licas* Klug. (123)

Insects which attack the foliage:

- 5 — *Laphygma exempta* Wlk. (44)
 6 — *L. exigua* Hübn. (45)
 7 — *Prodenia litura* Fabr. (47)

Insects which attack the flower and ear:

- 8 — *Chloridea obsoleta* Fabr. (42)

Insects which attack the grain:

- 9 — *Sitotroga cerealella* Oliv. (29)
 10 — *Tenebrioides mauritanicus* L. (54)
 11 — *Oryzæphilus surinamensis* L. (55)
 12 — *Sitodrepa panicea* L. (62)
 13 — *Lasioderma serricorne* L. (63)
 14 — *Tribolium confusum* Jacq. Duval. (70)
 15 — *T. ferrugineum* Fabr. (71)
 16 — *Sitophilus oryzae* L. (117)

Sugar cane insect pests

Insects which attack the root:

- 1 — *Pseudococcus calceolariae* Mask. (20)
 2 — *Anomala ustulata* Arr. (118)

Insects which attack the stalk:

- 3 — *Pseudococcus sacchari* Ckll. (22)
 1 — *Enneadesmus forficula* subsp. *capensis* Lesne (64)
 5 — *Heteronychs licas* Klug (123)

Tobacco insect pests

Insects which attack the stem:

- 1 — *Euxoa spinifera* Hübn. (43)
 2 — *Zophosis* sp. (66)

- 3 — *Psammodes scrobicollis* Fahrs. (68)
 4 — *Gonocephalum dermestoides* Gerst. (69)

Insects which attack the foliage:

- 5 — *Hippotion celerio* L. (37)
 6 — *Laphygma exigua* Hübn. (45)
 7 — *Prodenia litura* Fabr. (47)
 8 — *Colasposoma scutellare* Leef. (93)
 9 — *Aspidomorpha tecta* Boh. (98)
 10 — *A. apicalis* subsp. *confinis* Klug. (99)
 11 — *Conchyloctenia hybrida* Boh. (100)
 12 — *C. tigrina* Ol. (101)
 13 — *Hypocassida gibipennis* Boh. (102)

Insects which attack the terminal bud and fruit:

- 14 — *Chloridea obsoleta* Fabr. (42)

Insects which attack the stored tobacco:

- 15 — *Dermestes vulpinus* Fabr. (60)
 16 — *Lasioderma serricorne* L. (63)

Field tests of poison bait against hoppers of the red locust, 1935-36 *)

by

W. G. H. COATON, M. Sc.

I. EXPERIMENTS IN BAITING YOUNG HOPPERS.

Early in the summer of 1935—36 the Government maize meal bait was used for the first time against hoppers of the brown locust in the north-western Cape Province and in the western Orange Free State. When the first red locust hoppers of the season hatched at Chakaskraal, in Natal, in December 1935, the writer tested the departmental bait against them, and found that excellent kills could be obtained on hoppers of the first and second instars in plant cane one foot in height. The bait was prepared according to the formula: maize meal 92 lbs., molasses 7 lbs. and arsenite of soda 1 lb.

In January and February 1936, twelve tests were undertaken on a larger scale near Empangeni in Zululand on hoppers of the first to third instars. These tests were carried out mainly in young plant cane and ratoon cane one to two feet in height, with bare, well-cultivated soil between the rows. Especially on hot, sunny days the hoppers were killed quickly and effectively; in many cases the mortality was estimated at 95 % after about 36 hours. In tall ratoon cane, about five feet in height and forming a complete canopy over the rows, excellent kills were also obtained in three additional tests.

II. KWAMBONAMBI TESTS.

During the second half of February 1936 fourteen tests were carried out on hoppers of the third and fourth instars at Kwambonambi, near Empangeni. In the majority of these tests the area baited extended over one-half an acre to two acres; in one test only about one-fifth of an acre was baited and in three other tests the area baited covered 4, 7 and 9 acres respectively. In most cases the bands were baited in sparse grass, about one foot in height, with approximately one-third of the surface of the soil devoid of vegetation. The grass was of the wiry, sour type commonly found on the coastal sand-hills. In one test the band was located in a marsh with dense green vegetation about five feet in height. These tests at Kwambonambi gave very satisfactory and encouraging results

*) The writer is greatly indebted to Messrs. C. du Plessis and C. F. Jacot-Guillarmod for aid in the statistical analysis of the data presented in this paper.

in most cases; mortalities estimated at 85 to 95 % were obtained after about 48 hours in nine of the tests. Three of the tests gave fair mortalities, estimated at 50 to 70 %, and two were regarded as complete failures.

The Kwambonambi experiments indicated that it is not desirable to attempt baiting while the hoppers are trekking actively during the day, although considerable success could be obtained by baiting during active migration in tall dense grass. The best time of the day for the application of the bait was found to be early in the morning, late in the afternoon, and during the night, i. e. during the periods when the hoppers are least active. Moist conditions were found to be favourable for successful baiting. A dosage of about 65 to 130 pounds dry weight per acre was applied in these tests. The general impressions gained were (1) that a higher dosage was required for baiting in dense, tall vegetation than for baiting in sparse, short vegetation; (2) that the bait had to be as moist as possible, and that it had to be thrown hard, so that a large proportion of it would adhere well to the vegetation.

The writer also came to the conclusion that the bait was not particularly attractive to the hoppers; they only seemed to take it when they happened to stumble on a particle of bait in walking along a leaf or on the ground. In this respect the red locust hoppers differ strikingly from those of the brown locust, since the latter can be relied upon to stop on the bait even during active migration.

III. EXPERIMENTS CARRIED OUT AT MTUBATUBA, ZULULAND, MARCH—MAY 1936.

1. Introduction.

The experiments discussed in this section were carried out at Masimba, about 20 miles west of Mtubatuba in the hills of the Game Corridor. Whereas the tests undertaken during the month of February at Kwambonambi had been carried out in vegetation that was not always very dense, tall and green, the general conditions at Masimba were ideal for testing the bait under what had been considered the most unfavourable circumstances. There was a dense, luxuriant green covering of grass, ranging in height from two to six feet, and the frequent rains and heavy dews provided very moist conditions. No cattle were grazed on the experimental area.

The main objects of the experiments were to determine: —

(a) the dosage of maize meal bait required per acre under moist conditions and in dense vegetation;

(b) whether the addition of more molasses would increase the attractiveness of the bait;

(c) the comparative value of various bait carriers;

- (d) whether molasses is necessary;
- (e) whether a higher percentage of poison would increase the effectiveness of the bait, and
- (f) whether the baiting method could be recommended for use against hoppers in the 4th to 6th instars.

2. Technique.

The technique followed at Mtubatuba in 1936 was very largely the same as that described in a report now being prepared for publication as a science bulletin by Prof. J. C. Faure and Mr. C. F. Jacot-Guillarmod on their experimental work at Hluhluwe, Zululand in 1937, therefore, there is no need to give a detailed description in this paper. The Mtubatuba procedure differed from the Hluhluwe technique as follows: —

(a) Experiments in enclosures.

The writer used barriers 44 feet in length instead of 48 feet. The number of barriers was limited therefore, only five or six barriers could be erected for an experiment and one of these was used as a control. Consequently it was not practicable to replicate treatments on one and the same day.

More time was allowed to elapse between the completion of baiting and the taking of cage samples at Mtubatuba. The reason for this was that the taking of samples from the barriers was delayed until the free part of the band began to migrate. In the case of hoppers of the third and fourth instars, the samples were collected by means of a net, and the time elapsed between completion of baiting and commencement of catching of samples varied from one hour and a half to two hours and twenty minutes, the average being about one hour and fifty minutes.

In the case of hoppers of the fifth and sixth instars, the cage samples were taken by hand as the insects when scared hid away, making net collection impossible, and this proved to be a slow process. The hand collecting began from one hour and a quarter to four hours after completion of baiting, and lasted for about 40 minutes to one hour and a half. The hoppers for the control cages were also collected by hand. All control hoppers were taken from an enclosure, whereas the Hluhluwe controls were taken from the free part of the band.

For twelve of the experiments two cage samples were taken from each enclosure, and for four experiments only one cage was used for each enclosure. The number of hoppers per cage varied from about 100 in the case of 6th instar hoppers, to about 300 in the case of 3rd instar hoppers.

In some of the experiments a certain amount of difficulty was experienced owing to the fact that a large proportion of the hoppers

moulted in the cages, and some of the results were discarded on this account. In the case of the experiments discussed in this report the control cages showed very low mortalities, varying from 0 % to about 6 %.

The dipterous parasite *Blasoxypa* sp. interfered with the experiments to such an extent that the results of a considerable number of experiments were discarded because the controls showed high mortalities.

(b) Field experiments.

The areas occupied by the bands baited in the field tests at Mtubatuba were, in most cases, from five to ten times as large as the standard size plots (25 by 30 yards) adopted in 1937 at Hluhluwe. The results were arrived at by estimating the percentage dead and alive in the baited band after three to five days.

3. Dosage required per acre.

Four experiments were performed in enclosures on four different days to endeavour to determine whether there is an appreciable difference in the mortalities obtained with four different dosages, varying from 60 to 200 pounds (dry weight) per acre. Details of the conditions, and the results obtained, will be found in tables 1, 2 and 3.

Table 1: Dosage per acre: Details of conditions under which experiments were carried out in enclosures.

Dates: March 13th to 20th, 1936. Vegetation: conditions practically identical for the four sets of enclosures: dense green grass about 4 feet high completely obscuring the ground. Hoppers: mainly third instar. Bait: Departmental maize meal bait (maize meal 92, molasses 7, arsenite 1 lb.) Enclosures: 44 feet in circumference.

No.	Beginning of baiting			Interval: baiting to catching cage samples hrs. : mins.	Dew	Weather
	time a.m.	temp. ° F.	% R.H.			
M. 2.	7.10	71	90	1 : 40	heavy	partly sunny
3.	7	68	67	1 : 30	very little	sunny
4.	6.50	67	100	1 : 50	heavy	sunny
5.	7	68	95	2 : 20	heavy	sunny

Table 2: Dosage per acre: Percentage mortalities observed in cage samples after 56 hours. One cage sample taken from each enclosure.

No.	Dosages					Total	Control
	60 lbs.	100 lbs.	120 lbs.	160 lbs.	200 lbs.		
M. 2	88.7	92.1	93.2	95.8	94.8	464.6	4.6
3	71.4 ¹⁾	84.9	85.6	86.6	93.7	422.2	5.4
4	74.6	81.0	71.0 ¹⁾	96.4	93.3	416.3	0
5	85.8	70.1 ¹⁾	82.2	90.5	72.4 ¹⁾	401.0	0
Total	320.5	328.1	332.0	369.3	354.2	1704.1	
Average	80.1	82.0	83.0	92.3	88.6	85.2	

The figures marked with an asterisk ¹⁾ in table 2 do not represent observed mortalities. In these cases the hoppers moulted so extensively in the cages, that no counts were made at the time. In order to complete the set of figures for statistical analysis, the percentages were estimated according to the method described by A. R. Saunders (1935). (Statistical methods with special reference to field experiments — Un. So. Afr. Dep. Agr. & For. Sc. Bull. 147, 76 p.).

Table 3: Dosage per acre: Analysis of variance.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log_e$ (mean square)	Z	Z at $P = 0.05$
Replication	3	444.70	148.23	2.4994	0.4736	0.6250
Treatment	4	410.66	102.66	2.3154	0.2896	0.5907
Error	12	689.93	57.49	2.0258		
Total	19	1545.27				

Although the average percentage mortalities in table 2 seem to suggest that there was a slight advantage in using a dosage of 160 pounds, table 3 shows that there was no significant difference between any of the dosages under the conditions of these experiments. It should be pointed out that all these tests were undertaken with maize meal bait containing only one percent of arsenite of soda. The bait used in the following season with more consistent results against older hoppers contained 3% of arsenite in maize bran, which is approximately equivalent to 2% in maize meal.

4. Field tests at Mtubatuba.

Nine field tests of baiting against hoppers of the 4th to 6th instars were undertaken on different days in the Game Corridor from March 30th to May 1st, 1936. Details concerning the conditions obtaining at the time of each test, and the estimated percentage kills will be found in table 4.

Table 4: Field Tests at Mtubatuba, April 1936.

Bait: Departmental maize meal (1% arsenite plus molasses) used in all tests (except 8a); 8 gallons of water added per 100 lbs bait. Maize ear meal (1% arsenite plus molasses) used in 8a. Double strength molasses added to half of plot 6. Vegetation: green in all cases.

No.	Dosage per acre in lbs. dry weight	Time of baiting	Time spent on bait	Instar	Estimated percentage mortality.	Duration of test in days.
8a	100	6.45 a.m.	3 hours	6th	35	4
8b	100	7.30 a.m.	2 hours	6th	20	1
1	140	10 a.m.	3 days	4th	45	5
2	160	6.30 a.m.	3 hours	5th	95	3
3	150	11.30 a.m.	1½ hours	5th	75	1
4	130	4 p.m.	15 hours	5th	95	3
5	107	9 p.m.	15 hours	5th	99	3
6	130	7 a.m.	2½ hours	6th	85	3
11	120	7.10 a.m.	4 days	6th	50	6

Table 4 (continued).

No.	Vegetation	Dew at time of baiting	Weather	Acreage baited (approx)	Temp. ° F. % R.H.	
					At time of baiting	
8a	Sparse, about 18" high	very little	strong wind.	1¼	62	89
8b	mainly sparse 9" to 24" high	do.	do.	1	69	90
1	dense, 3 to 5 feet.	grass wet from rain	dull, partly rainy	5	72	82
2	do.	heavy	sunny	1½	71	100
3	do.	none	sunny	1¾	84	73
4	do.	none but heavy during night.	fan	¾	82	80
5	dense 18" high	heavy	clear	¼	73	86
6	dense 2 to 5 feet	slight	sunny	1½	66	90
11	mainly dense 1—3 feet high	very heavy	misty	1½	68	95

If an estimated kill of 50% or lower is regarded as a failure, and a kill of 75% and higher as a success, the results of these nine tests may be classified as: successes 5, failures 4. It is difficult to account for the inconsistency of these results in any other way than to assume that the low poison content (1%) was the cause of the failures, and yet, five out of the nine tests gave good results. The two evening baitings (Nos. 4 and 5) were both very successful, but three of the morning applications (Nos. 2, 3 and 6) gave kills estimated at 95, 75 and 85% respectively. The indications are that heavy dew is favourable: of tests undertaken with heavy dew present, one was a failure (No. 11) and three were very successful (Nos. 2, 4 and 5). Test No. 1 was performed on a rainy day, and the grass was wet from rain; the results were poor (45%) but some rain fell during the course of the baiting operations.

It is interesting to note that both tests carried out in sparse, short vegetation, with one-quarter to half the area showing as bare ground, (Nos. 8A and B) were failures. In both these cases there was very little dew, and the wind was noted as strong, whereas only mild winds were noted for all the other tests. On the other hand, tests

Nos. 3 and 6 were also carried out in the absence of heavy dew, and the estimated kills were 75 and 85%, respectively.

As far as dosage per acre is concerned, the field tests gave no very clear indications. The dosages varied from 100 to 160 pounds per acre. The higher dosages yielded 4 successes and one failure, and the low dosages one success and three failures. The very best result, 99%, was obtained in test No. 5 with only 107 lbs per acre; the grass was only 14"—18" high, but so dense that it completely obscured the ground.

On the whole, the results of these field tests were rather conflicting, and it is therefore not possible to draw definite conclusions from them. For this reason the writer could not recommend baiting as the standard control measure against hoppers of the 4th to 6th instars in 1936.

5. Increase of molasses content.

From observations made in the field during the summer of 1935—36, the writer came to the conclusion that the departmental maize meal bait was not attractive to the hoppers of the red locust. It was observed that hoppers walked past bait particles on the leaves of plants without paying any attention to them, even if they were no more than about half an inch away; it therefore seemed obvious that the bait particles were only eaten when hoppers walked directly over them.

Experiments were therefore undertaken with baits containing more molasses than the departmental bait, in order to determine whether the bait could not be made more attractive by increasing the molasses content. Four experiments were carried out on four different days, in enclosures, using baits containing 7%, double, treble and quadruple amounts of molasses, respectively. Details of the conditions obtaining at the time of the experiments, and the results obtained, will be found in tables 5, 6 and 7.

Further details concerning the four experiments listed in tables 5 and 6 were as follows: —

Dates: March 27th to April 3rd 1936. *Vegetation:* Conditions very similar in the four sets of enclosures: dense green grass from 18 inches to 4 feet in height, completely obscuring the ground. *Hoppers:* — M. 6 and 7: 4th instar, M. 9 and 10: 5th instar. *Bait:* Standard maize meal bait containing 7 % molasses was compared with the same bait to which double, treble and quadruple amounts of molasses had been added: —

(1) Standard molasses: maize meal 92 lbs, molasses 7 lbs, arsenite of soda 1 lb.

(2) Double molasses: maize meal 92 lbs, molasses 14 lbs, arsenite of soda 1 lb.

Table 5: Increase of molasses content: Details of conditions under which experiments were carried out in enclosures.

No	Beginning of baiting			Interval: baiting to catching cage samples: hours : mins	Dew	Weather
	Time a.m.	Temp. ° F.	% R.H.			
M. 6.	7.25	71	81	1 : 50	moderate	sunny
7.	7.15	73	65	1 : 35	none	sunny
9.	7	65	100	1 : 50	wet after rain	sunny
10.	7.10	72	86	1 : 15	slight	sunny

(3) Treble molasses: maize meal 92 lbs, molasses 21 lbs, arsenite of soda 1 lb.

(4) Quadruple molasses: maize meal 92 lbs, molasses 28 lbs, arsenite of soda 1 lb.

The same quantity (6.6oz dry weight per 44' enclosure, i.e. 120 lbs per acre) of maize meal bait was weighed for each enclosure, and the additional amounts of molasses were added to Nos. (2), (3) and (4). On a weight percentage basis the baits therefore contained respectively 1 %, 0.93, 0.87 % and 0.82 % of arsenite of soda, but for practical purposes it may be considered that they all contained 1 % of arsenite of soda.

Dosage per acre: 120 lbs throughout. *Enclosures:* 44 feet in circumference.

The periods which elapsed between the taking of cage samples and the final readings of percentage mortalities were: — M. 6, about 81 hours, M. 7 about 77, M. 9 and 10 about 56 hours.

Reference to table 6 shows that the average mortalities observed in cage samples, after baiting with the baits containing the four different concentrations of molasses, varied from about 51 to 59 per cent. The lowest average mortality was obtained with bait containing treble molasses, and the two highest averages with the baits containing double and quadruple molasses. As shown in table 7, the analysis of variance gives a value for Z which is smaller than Z at $P = 0.05$, indicating that there is no significant difference between the mortalities observed in the enclosures baited with the baits containing different concentrations of molasses.

Table 6: Increase of molasses content: Percentage mortalities observed in cage samples.

No.	(1) Standard molasses	(2) Double molasses	(3) Treble molasses	(4) Quadruple molasses	Total	Control
M. 6	57.4	56.6	46.6	66.6	227.2	2.2
7	13.1	29.0	10.1	13.0	65.2	2.9
9	78.1	80.4	79.8	82.5 ¹⁾	320.8	0.6
10	68.7 ¹⁾	70.1	69.3	69.9	278.0	2.2
Total	217.3	236.1	205.8	232.0	891.2	
Average	54.3	59.0	51.5	58.0	55.7	

The figures marked with an ¹⁾ were estimated (see note under table 2, above). Two cage samples were taken from each enclosure, except in the case of the controls, from which only one cage sample was taken.

Table 7: Increase of molasses content: Analysis of variance for table 6.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ (mean square)	%	Z at P. = 0.05
Replication	3	9377.04	3125.68	4.0237	2.2923	0.6757
Treatment	3	145.20	48.39	1.9396	0.2082	0.6757
Error	9	287.25	31.91	1.7314		
Total	15	9809.48				

A further point of interest that emerges from the figures in table 7 is that the $\frac{1}{2} \log e$ for replication is greater than the corresponding figures for treatment and for error. This indicates that there was more variation in these experiments due to unknown variables than to the different concentrations of molasses used in the treatments.

We may therefore conclude that these experiments gave the following indications: —

(a) that increasing the molasses content of the maize meal bait to double, treble and quadruple amounts did not produce significantly better mortalities, and

(b) that the additional molasses did not make the bait less attractive to the hoppers.

6. Comparison of different carriers.

As shown in the preceding subsection of this report, experiments and observations had indicated that the maize meal bait was not attractive to the hoppers, and that an increase of the molasses content did not result in better mortalities. Therefore a series of experiments was performed in enclosures, in order to compare the effectiveness of various other bait carriers with that of maize meal; at the same time observations were made on the spreading qualities of these carriers.

(a) Description of carriers used.

The carriers tested were: --

1. *Maize meal.* This was the standard departmental whole maize meal bait issued from about November 1935, and prepared in a private factory according to the formula: maize meal 92 lbs molasses 7 lbs and arsenite of soda 1 lb. The specifications laid down for the bait were (a) Moisture: the finished product must not contain more than 10 % of moisture and (b) fineness: 100 % must pass through No. 10 I.M.M. sieve, 97 % through No. 18 I.M.M. sieve, and not more than 55 % through No. 3 I.M.M. sieve. Experience showed that millers had difficulty in producing a meal that would conform exactly to these specifications; they reported that it was not practicable to keep the percentage of the fine particles, which pass through the 30 I.M.M. sieve, down to 55%. It must, therefore, be understood that the maize meal used in these experiments did not conform exactly to the above specifications. „Whole meal” means a meal consisting of the whole of the grain, including the bran.

It would be better, in specifying the fineness of maize meal for locust bait, to prescribe a grade of fineness that is regularly produced by millers in the ordinary course of their business. There is a certain amount of risk that the meal may be too fine, and this will result in a tendency to lump-formation. Lumps are a danger to stock, especially in the Cape Province where it is customary to feed crushed maize to sheep during droughts. Therefore the type of meal selected should be carefully tested for mixing, spreading and sowing qualities. It is probable that the grade of maize used may also be a factor influencing the spreading qualities of the meal.

Spreading qualities: maize meal was ranked first amongst the carriers tested on the basis of spreading qualities. It sowed well, gave a good coverage, and did not tend to form lumps.

2. *Maize ear meal*. This consisted of the ears of maize, including the leaf-sheaths or husks, the grain and the cob, all ground together in a hammer mill. It was slightly coarser than the maize meal. On the basis of spreading qualities, ear meal was ranked second. It sowed almost as well as maize meal, and gave a good coverage, without lumps. Owing to its lower specific gravity this carrier could not be sown as well against the wind as maize meal.

3. *Ground oat bran*. This was a byproduct of a breakfast oat factory, and it consisted largely of ground oat bran. It was found to be rather difficult to wet thoroughly. Its spreading qualities were found to be distinctly inferior to those of maize meal and maize ear meal, and also inferior to the mixtures Nos. 4 and 5 below. If not enough water was added, the oat bran was too light to sow; if more water was added it formed lumps both in mixing and in sowing. Instead of giving a good even coverage of small particles, it fell in lumps about as large as peas or beans.

4. *Ground oat bran plus maize meal (2 : 1 by volume)*. This mixture was ranked, on spreading qualities, as being about as good as No. 5 below; it was considered much better than oat bran alone, but inferior to maize meal and maize ear meal.

5. *Oat hay meal plus maize meal. (2 : 1 by volume)*. Oat hay meal consisted of oat hay, including the grain in the ear, ground fine in a hammer mill. When used alone it sowed badly, gave very poor coverage, and tended to fall in lumps as large as peas and even walnuts. When mixed with maize meal (2 volumes oat hay meal plus one volume maize meal) a mixture was formed which was ranked, on spreading qualities, as being as good as the mixture of ground oat bran and maize meal (no. 4 above).

6. *Barley meal*. This consisted of barley grain only, ground in a hammer mill; the bran was not sifted out of the meal. This carrier was found to have the worst spreading qualities of all the materials tested. When mixed with water it forms a very sticky mixture, almost like dough, and when spread it falls in lumps.

7. *Barley meal plus maize meal (2 : 1 volume)*. This mixture was ranked on spreading qualities as being scarcely better than barley meal alone, possibly almost as good as oat bran alone.

(b) The first series of tests.

In the first series of tests, the first five carriers described above were compared. Details of the conditions under which the tests were performed, and the results obtained, will be found in tables 8, 9 and 10.

Table 8: Comparison of different carriers: Details of conditions under which experiments were carried out in enclosures.

No.	Beginning of baiting			Interval baiting to catching cage samples hours : mins	Dew	Weather
	time, a.m.	temp. ° F.	% R.H.			
M. 12.	7.30	68	95	2 : 10	heavy	sunny
14.	7 15	64	100	3 . 5	heavy	sunny
15.	7.15	65	100	3 . 45	heavy	misty
16.	6.50	62	100	3 25	heavy	sunny

Further details concerning the experiments reported on in tables 8 and 9 are listed below: —

Dates: April 8th to 24th, 1936.

Vegetation: Green in all cases; no bare ground visible in enclosures in M. 14 and 15, but in M. 12 and 16 about one-quarter of the area of the enclosures was visible as bare ground; height of grass: in M. 12 and 14 about 3 feet, in M. 15 and 16 about 1½ feet.

Hoppers: M. 12: 5th, other tests 6th instar.

Bait: (1) Standard maize meal bait containing 7% molasses and 1% arsenite of soda.

(2) Maize ear meal.

(3) Ground oat bran.

(4) Ground oat bran 2 volumes plus maize meal 1 volume.

(5) Oat hay meal 2 volumes plus maize meal 1 volume.

Of the carriers (2), (3), (4), and (5) a volume equal to the volume of maize meal bait required for a given dosage (e. g. 8.8 ozs per enclosure for 160 lbs per acre) was measured out. To this volume of the carrier was added the amount of arsenite of soda and molasses contained in the corresponding quantity of maize meal bait (e. g. 8.8 ozs in the case of the dosage 160 lbs per acre). Therefore all baits contained approximately 1% of arsenite of soda and 7% of molasses.

Enclosures: 44 feet in circumference.

Dosage per acre: see table 9.

Table 9: Comparison of different carriers: Percentage mortalities observed in cage samples after 50 to 56 hours. Two cages samples per enclosure, except controls: 1 per enclosure.

No.	(1) Standard maize meal	(2) Maize ear meal	(3) Ground oat bran	(4) Oat bran plus maize meal	(5) Oat hay meal plus maize meal	Total	Dosage per acre	Control
M. 12	98.0	90.2	73.2	70.3	65.1	396.8	160	0
14	89.6	91.6	55.1	83.1	80.0	399.4	120	5.7
15	88.1	95.2	68.9	89.0	92.0	433.2	100	0.8
16	90.1	97.8	66.9	73.1	90.5	418.4	100	0
Total	365.8	374.8	264.1	315.5	327.6	1647.8		
Average	91.5	93.7	66.0	78.9	81.9	82.3		

Table 10: Comparison of different carriers: Analysis of variance for table 9.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log_e$ (mean square)	Z	Z at P = 0.05
Replication	3	176.04	58.68	2.0359		
Treatment	4	1961.63	490.41	3.0976	1.0051	0.5907
Error	12	787.99	65.67	2.0922		
Total	19	2925.66				

It will be seen from table 9 that the average percentage mortality obtained with ground oat bran was distinctly lower than those obtained with the four other carriers. Table 10 shows that the differences due to treatment are significant since Z is greater than Z at P = 0.05. By the usual method, we find that when "P" = 0.05 a difference of 12.5 % between average mortalities would be significant.

It follows that ground oat bran gave significantly poorer results than the other four carriers in this series of tests. The difference between the average percentage mortalities obtained with oat bran and the mixture of this and maize meal (carrier 4) is 12.9, which is not much greater than the calculated significant difference.

In view of the notes quoted above with reference to the poor spreading qualities of ground oat bran, it is not surprising that the results should be poorer than those obtained with the other carriers. Unless a very large dosage per acre is applied, one should expect to obtain better results with a carrier that spreads well than with one that spreads badly. Since the hoppers apparently feed on the bait only when they happen to walk over a particle of it, the bait should be finely divided and evenly spread over the vegetation. Ground oat bran cannot be recommended as a suitable carrier if it is used alone.

The mixture of ground oat bran and maize meal (carrier 4) gave an average mortality of 78.9, which is significantly poorer than the average for maize ear meal and maize meal. The difference between the averages for mixture (1) and maize meal is 12.6, which is practically equal to the calculated significant difference. Mixture (4) was not significantly poorer than the mixture of oat hay meal and maize meal.

It may therefore be concluded that a mixture of ground oat bran (2 volumes) and maize meal (one volume) is not as good a carrier as maize meal or maize ear meal. The differences between the average percentage mortalities observed were not so great as to rule out this mixture (no. 4) altogether. It must be borne in mind in this connection that locust officers and farmers are usually unable to control the dosage scattered per acre to any great extent in actual field work, and that the general tendency probably is to scatter rather high dosages. Therefore, the practical results obtained in a campaign with the mixture (No. 4) would probably not be noticeably inferior to those obtained with maize meal or maize ear meal.

Carrier No. 5, the mixture of oat hay meal and maize meal, gave an average percentage mortality of 81.9, which is not significantly lower than those obtained with maize meal and maize ear meal. No. 5 was significantly better than ground oat bran. The mixture of oat hay meal (2 volumes) and maize meal (1 volume) can therefore, be recommended as a good carrier that would give satisfactory results in practice. Its spreading qualities were considered to be inferior to those of maize meal, and maize ear meal, but not so far inferior that one need to hesitate to use the mixture on a large scale.

Maize meal and maize ear meal (Nos. 1 and 2) gave the highest percentage mortalities, and both these carriers were classified as

good spreaders. They can both be confidently recommended as excellent carriers for use in campaigns against red locust hoppers.

The results obtained in this series of tests appear to indicate that high mortalities are positively correlated with good spreading qualities of the bait carrier.

(c) The second series of tests.

In the second series of tests, carriers Nos. 1, 2, 5, 6, and 7 (see "a" above) were compared. Two experiments were performed; the details of the conditions, and the results obtained, will be found in tables 11, 12 and 13.

Table 11: Comparison of different carriers: Details of conditions under which experiments were carried out in enclosures.

No	Beginning of baiting			Interval: baiting to catching cage samples hrs : mins.	Dew	Weather
	time, a.m.	temp. ° F.	% R.H.			
M. 18.	7.15	68	76	3 : 30	very little	sunny
19.	7	63	100	4 : 0	heavy	sunny to cloudy

Further details concerning tests Nos. M 18 and 19 were as follows: —

Dates: 27th and 29th April 1936.

Vegetation: Green and dense in all enclosures, no bare ground visible; height of grass 2 to 4 feet.

Hoppers: 6th instar.

Bait: (1) Standard maize meal bait containing 7 % molasses and 1 % arsenite of Soda, at 100 lbs per acre, i. e. 5.6 oz (dry) per 44' enclosure.

(2) Maize ear meal.

(5) Oat hay meal 2 volumes plus maize meal 1 volume.

(6) Barley meal.

(7) Barley meal 2 volumes plus maize meal 1 volume.

Of the carriers (2) (5) (6) and (7) a volume equal to the volume of 5.6 oz. maize meal was measured out, and to this was added the amount of arsenite and molasses contained in 5.6 oz. of maize meal bait. Therefore, all baits contained approximately 1 % of arsenite and 7 % of molasses.

Enclosures: 44 feet in circumference.

Table 12: Comparison of different carriers: Percentage mortalities observed in cage samples after 73 (M. 18) and 56 (M. 19) hours. Two cage samples per enclosure, except controls: 1 per enclosure.

No	(1) Standard maize meal	(2) Maize ear meal	(5) Oat hay meal plus maize meal	(6) Barley meal	(7) Barley meal plus maize meal	Total	Control
M. 18	17.6	54.5	54.5	50.2	39.8	216.6	1.3
19	73.3	80.1	69.1	48.6	64.3	335.4	0
Total	90.9	134.6	123.6	98.8	104.1	552.0	
Average	45.5	67.3	61.8	49.4	52.1	55.2	

Table 13: Comparison of different carriers: Analysis of variance for table 12.

Due to	Degrees of freedom	Sum of squares	Mean square	$\frac{1}{2} \log e$ (mean square)
Replication	1	1411.35	1411.34	3.6260
Treatment	4	657.19	164.30	2.5505
Error	4	875.47	218.87	2.6944
Total	9	2944.01		

As shown in table 13, the variations due to replication and error were greater than the variation due to treatment. This indicates that there was no significant difference between the average percentage mortalities obtained with the five carriers tested in these two experiments.

It should be borne in mind that barley meal (6) and the mixture of barley meal and maize meal (7) were classified (see "a" above) as being poor spreaders. They can, therefore, not be recommended as suitable carriers for use on a large scale against red locust hoppers, although the results in table 12 seem to indicate that they are about as effective as maize meal and maize ear meal.

In view of what has been said above about ground oat bran (in "b" first series of tests), it is very surprising that such good results were obtained in test M. 18 and 19 with the poor spreaders barley meal and barley meal plus maize meal. On the other hand, the figures in table 12 are based on two experiments only, in which the results varied considerably, and it is doubtful whether one would be justified in drawing important conclusions from them.

7. Omission of molasses and increase of poison content.

As stated in the introduction to section III. above two important aspects which the writer planned to study were whether molasses was necessary in bait, and whether a higher percentage of poison would not be more effective. Tests designed to throw light on these two points were carried out on several occasions. Unfortunately the bands of hoppers used for these tests proved to be heavily infested with the larvæ of the dipterous parasite *Blasoxypa* sp. There was such a heavy mortality in the control cages in these experiments that the results were discarded as being of no value.

IV. GENERAL CONCLUSIONS.

The experiments and observations discussed in this paper gave the following indications: —

(I) Maize meal bait, containing 1 % arsenite of soda and 7 % molasses, can be used with excellent results in the destruction of hoppers of the red locust in their first to fourth instars.

(II) Dense, green, and succulent vegetation offers favourable conditions for successful baiting, even if it is up to five feet in height.

(III) Moist conditions resulting from rains and heavy dew do not interfere with the successful use of bait; on the contrary, moisture favours successful baiting.

(IV) The best time to apply the bait is early in the morning, late in the evening, or during the night, when the hoppers are least active. As a general rule, baiting is not successful during active migration.

(V) The bait is not particularly attractive, and is eaten only when hoppers happen to walk over it; therefore the bait should be spread evenly over the vegetation, and it should be used in a wet state and thrown hard so as to increase the chances of its sticking to the plants.

(VI) A dosage of about 90 to 120 pounds (dry weight) per acre is necessary in order to obtain satisfactory kills in dense, green vegetation.

(VII) Experiments carried out to compare dosages varying from 100 to 200 pounds of maize meal per acre indicated that there was no significant difference between the mortalities obtained with the different dosages.

(VIII) Field tests of maize meal bait containing 1 % of arsenite of soda against hoppers of the 4th to 6th instars did not give consistently good results; therefore baiting could not be recommended in 1936 for adoption by the Department of Agriculture and Forestry as its standard measure for the control of the older hoppers.

(IX) Increasing the molasses content to 14, 21 and 28 % did not result in better mortalities than those obtained with maize meal bait containing only 7 % of molasses.

(X) (a) Seven carriers and mixtures of carriers were compared in tests carried out in enclosures. Maize meal, maize ear meal, and a mixture of oat hay meal (2 volumes) plus maize meal (1 volume) gave the best results, and these three materials can be recommended as excellent carriers for poison bait to be used in campaigns against hoppers of the red locust. Owing to the difficulty of obtaining sufficient supplies of maize ear meal and oat hay meal, and of having these materials ground, only maize meal is likely to be used on a large scale by the Government.

(b) Ground oat bran is a poor spreader, and the mortalities obtained with this carrier were significantly poorer than those obtained with the three good carriers referred to in the preceding paragraph (a). A mixture of ground oat bran (2 volumes) and maize meal (1 volume) was somewhat inferior to maize meal alone, but this mixture could probably be used with satisfactory results on a large scale.

(c) Barley meal (grain only) was found to be a very poor spreader. But in two experiments the results obtained with this carrier, and a mixture of barley meal and maize meal, were not significantly different from those obtained with maize meal and maize ear meal. In any case the strong tendency to lump in these two carriers rules out their use, as the risk of poisoning stock would be increased.

A layman collects and breeds fruit flies

by

W. E. MARRIOTT.

This short article will, it is hoped, be of interest to entomologists, be they professionals or laymen. It is a brief outline of how the writer first became interested in fruit flies: an interest which grew into an absorbing hobby, and at the same time added much to the knowledge of this branch of entomology. Fruit growing, an elementary knowledge of botany, and a love of the countryside were qualifications perhaps well suited to lead one into work of this nature.

Yet even with abounding enthusiasm the efforts of a layman need direction and guidance by those competent to give it, if they are to become intelligently useful. This guidance was forthcoming, thanks to the ready co-operation of Mr. H. K. Munro, Collection Entomologist at Pretoria, Dr. L. B. Ripley and Mr. G. A. Hepburn of Cedara, and much help given by botanists at the Durban and Pretoria herbaria. Without this co-operation the gathering of so much scientific knowledge would not have been possible.

It would seem that in whatever part of the world fruit is grown, the grower is faced with the problem of pests, and South Africa is certainly no exception. About nine years ago Dr. Ripley and Mr. Hepburn gave serious attention to fruit flies and their control. Their researches, as many of the readers of this Journal will know, included experiments designed with a view to discovering effective attractants and repellents. Under their direction numerous tests of different baits were carried out in a Durban sub-tropical orchard, adjacent on one side to indigenous bush. It is hardly within the scope of this article to deal with these experiments and the knowledge gained from them. They are mentioned because they actually provided an introduction to the really serious work of collecting and breeding, which has engaged the attention of the writer for the last six years. However, in passing, it may be mentioned that, with the layman's mind, the writer did have visions of the eradication of one of our worst fruit pests, the Natal fruit fly *), particularly when nearly 60.000 males of this fly were trapped in the orchard during a period of six months. It was a good indication that fruit flies are really numerous; but eradication — well, that is not a popular word with entomologists!

While the experiments with different baits were being carried out in the Durban orchard, all fruit flies recovered from the traps

*) *Ceratitis rosa* Ksh.

were put into alcohol and sent to Cedara. It was at once noticed that, apart from the usual fruit pests, many other species of fruit flies were also being trapped ; it was when these were sent to Mr. Munro for identification that the possibilities of trapping, as supplementary to ordinary collecting, were revealed. For two years trapping was done regularly, and all fruit flies other than the well known pests of fruit were sent in alcohol to Pretoria during that period. It was eventually found that no less than 60 different species of fruit flies had been recovered from the traps, many of them representing species new to science. The quest for this information has taken the writer to many parts of the country: High Veld, Low Veld, Thorn Veld, Karroo, Coast Bush, Inland Bush, Rivers and Mountains; in fact, from where the waves break on the sea-shore to the snow line of the Drakensberg, for wherever there is vegetation fruit flies may be found if they are diligently looked for. Hundreds of miles have been travelled in search of infested fruits, flowers, galls and for those flies which bore into the stems of certain plants. Of new species taken in the traps and others which had been netted by various collectors, many hosts have been found, and a number new species were also bred. Yet there remains much to be done, and probably there are many more new species awaiting discovery. The field work and the gathering of material was preliminary to much work in the insectary.

Breeding cages had to be prepared, and constant attention had to be given to the material before and after the emergence of flies. One lot of puparia *) has been tended for over two years, and flies emerged up to twenty months after pupation. The enjoyment occasioned on the emergence of a new species and the watching, as they develop, of the varied colours and patterns has to be experienced before it can be fully appreciated. Then also for record purposes, specimens of parasites of the flies were collected, and samples were taken of pupal cases of emerged flies.

This most engrossing work has been constantly stimulated by the encouragement given by the band of helpers already referred to. Over two hundred rearings have been made, and of these about fifty still await identification. The results of the work up to date are reflected in the following records.

First rearing of a species representing a new genus	2
First rearing of a new species	13
First known rearing of a known species	10
A new host plant for a known species	31
A known host plant for a known species	12

*) of *Sclerophthus glaphyochalaps* Mro.

Collecting fruit flies has not the same popular appeal as collecting the many beautiful species of butterflies and moths, yet it can provide thrills, as shown by the very unusual conditions which attended one important find. A few years ago the writer was camping on the Natal Drakensberg with a small party. The party, with pack-horses and provisions, had left the main camp, where tents had been erected to shelter the assembled mountaineers. The idea was to establish a sub-camp nearer to the 10,500 feet summit of the Berg which was to be scaled. In the late afternoon a suitable cave was located. As previous occupants would appear to have been baboons, the cave was cleaned, bedding was unpacked and firewood gathered. At sundown preparations for the evening meal were commenced. Some juicy steak was to be roasted over the open fire and thin sticks with sharpened points were needed on which the pieces of meat might easily be threaded. The writer cut a couple of stems from a plant growing near the cave, removed the bark, and proceeded to sharpen them, but somehow they would not sharpen properly though several attempts were made. The stems were hollow; and then came the sudden thought that this hollowing might be the work of a stem-borer, and perhaps a trypetid too! By the light of the fire they were carefully sliced open, and sure enough three puparia were revealed.

During succeeding days a thorough search was made for more material but it met with no success. The plant generally grows near rivers, but it has never since been found high up at the base of a krantz as in the case of the first plant near the cave. The three puparia were tended during the remainder of the camping period, and some time after arrival back in Durban one imperfect fly emerged. Attempts, entailing the travelling of long distances, were subsequently made to procure more material, but these also met with failure. Two years later further efforts were crowned with success and over one hundred puparia were collected in another part of the Drakensberg. The fly proved to be a new species of *Stenotrypeta* *), and the host provides the only instance on record in South Africa of a trypetid fly infesting a plant **) belonging to the Natural Order *Umbelliferae*.

Then there was the occasion when a plant was pulled up for examination, and it so happened that a second plant came from the soil with it. This second plant had one leaf on which a gall was found, and eventually a fruit fly emerged from it: at present the only instance of a leaf-gall being made by a trypetid fly in South Africa.

One of the reasons which prompted the writing of this article for the Journal, was, that it might indicate to professional entomologists the possibilities there are in co-operation with suitable laymen. To the

*) *Stenotrypeta marriotti* Mro.

**) *Polemannia grossulariifolia*.

likely layman, there are opportunities for the pursuance of a healthy and absorbing „Nature Hobby” under proper direction and moreover, the satisfaction of doing something which would add to the sum total of scientific knowledge.

The Editor has asked me to add a few words about the really valuable work that has been done by Mr. W. E. Marriott in increasing our knowledge of a very important family of flies. The Trypetidæ, commonly known as fruit-flies form, a group that is important because several of its members are of great economic significance. Besides, the study of all the various species (300 or more are known from Southern Africa) and their grouping in genera and larger groups, as well as the variations within the species themselves, is of value in the wider studies of evolution and kindred subjects. For this work much material is needed, and if Mr. Marriott has done nothing else, he has helped to get together specimens of many species, often in good series.

In addition, from the economic point of view, the breeding work that he has done has added new records of the native host-plants, many previously hardly suspected, of various species and of the Natal fruit fly in particular. He has also accumulated data on the seasonal infestation of various fruits, all facts that must be considered when methods for the control of an injurious species are being sought. Apart from the actual data relating to known pests, there is much of what may be termed economically negative, but, in its own way, important information. Thus, through Mr. Marriott's work it is known that the pest species apparently do not breed in certain native fruits; and that quite a number of fruit flies living in various wild fruits, do not seem to show any signs of attacking cultivated fruits. May it be added, however, that in dealing with living organisms, one can never be too sure?

Much of the data gathered by Mr. Marriott has already been published in papers in recent numbers of the Entomology Memoirs issued by the Division of Plant Industry; much, too, still awaits publication. Many difficult problems in classification arise in naming such material as Mr. Marriott has collected; biological data cannot well be published until the identity of the species concerned is properly established.

In passing, too, it may be mentioned that other problems have arisen. Mr. Marriott says that the baittrap material was placed in alcohol. The preservation of flies in a wet medium is not recommended, but in the case of the bait-trap catches, the wetting of the specimens was unavoidable, owing to the nature of the bait. In the case of the pest species this was of no great moment as the flies,

after removal from the rather thick bait, were washed to some extent, then counted and discarded. When, however, it proved of value to save material for later systematic study, something had to be done to get the specimens in a suitable condition for this purpose. In the first place the flies could not be properly examined while in a liquid, and then the alcohol gradually caused their colours to fade; their removal from the alcohol was therefore essential. This was done by passing the specimens through increasing strengths of alcohol up to 95 % over a period of a week or more. Finally they were put into ether for an hour or so and pinned while still wet with the ether. The final ether bath was particularly necessary, as it evaporated so rapidly that the wing membranes did not fold over and stick together, as usually happened if only alcohol was used.

Another small difficulty was that, due to the removal of all body fats in the ether, the specimens failed to stick to the pin, and each had to be carefully glued to the pin with a tiny spot of Canada balsam or Seccotine on the underside.

Finally, Mr. Marriott had proved to be an ideal field collaborator. He is a keen and careful observer, and he is always ready to do his best to secure material or data. The help given by him not only to me, in the general study of the classification of these flies and their general biology, but also in the control investigations carried on under the direction of Dr. L. B. Ripley by the Entomologists at the Cedara School of Agriculture in Natal, has been of much value. This shows that a person interested in natural phenomena can co-operate to great advantage with workers in more specialized fields of endeavour.

H. K. MUNRO

Some new species of South African Trypetidae (Diptera), including one from Madagascar

by

H. K. MUNRO

Dacus (Dacus) hargreavesi n. sp.

Very like both *Dacus purus* Curr., and *D. ghesquierei* Coll. *). There is, however, at least in the specimens with a more darkly developed wing-pattern, a distinct, although rather pale, apical spot at the tip of the wing. Further, there is no median, post-sutural, yellow spot or stripe on the mesonotum and no yellow fascia on the second abdominal segment. As to whether all three may prove to be but forms of one species can only be decided when more material is available for study.

Type ♂ and two ♂ paratypes, Uganda, Nawandala, 11. 2. 1924. Coll. II. II (argreaves), No. 901.

♂. Length 6.0 mm., of wing 5.0 mm. A black species. *Head*, proportions of length, height and width, 4, 5 and 6. Frons narrow, about one fourth width of head and twice as long as wide, brown, ocellar dot and elongate triangular vertical plates shining blackish brown, bristles black, two inferior orbitals, superior orbitals apparently usually absent, but in one specimen a weak, hair-like bristle is present, the ocellars minute, hair-like, slight pale pubescence in middle; occiput blackish brown, the orbits narrowly and obscurely yellowish, no yellow spots on vertex and only a trace behind; lunule yellowish brown; antennæ of usual length, the first joint short and the second and third together about equal in length to the cheeks, arista brown at base; face short, shining black, ferruginous at lower corners including genæ; palpi yellow, blackish basally; proboscis blackish, yellow outwardly.

Thorax black with pale pubescence and slight dust; yellow are humeri (except anterior corner), broad mesopleural stripe touching sternite and notopleural callus, an isolated sutural spot, single hypopleural spot and scutellum except narrow black base; bristles black, anterior supra-alar present, the middle scapulars as strong as the outer, the scutellars about the length of scutellum apart. Halteres yellow. Legs: coxæ blackish-ferruginous, femora blackish, the basal fourth of first, basal third of second and basal half of third yellow, tibiæ ferruginous, the fore and middle pairs yellowish apically, tarsi

*) Collart, Bull. Mus. r d'Hist. nat. de Belgique, XI, 30-31, 1935

yellow. Wing very like figures given by Collart (l.c.) ; stigma brown, marginal and sub-marginal cells pale yellowish hyaline, in the type and one paratype a distinct, darker spot in the tip of sub-marginal cell, just crossing over end of third vein; in both these also the extreme bases of the marginal and sub-marginal cells are infuscated to the upper cross-vein; in the other paratype the apical spot is practically absent and only the base of the marginal cell is infuscated. In all the upper cross-vein is broadly infuscated. Anal stripe broad, filling anal cell and inner corner of third posterior cell, narrowing to end before the wing-margin. Point of anal cell moderately wide, about two and a half times length of rest of sixth vein to wing-margin; there is a cloud below the end of sixth vein. *Abdomen*: tergites fused; rugose with whitish pubescence; black, no yellow fascia on second segment, at most in one specimen a slight ferruginous tinge on the hind edge, the apex, including the „apical patches” reddish. Genitalia and venter blackish.

Dacus (Dacus) fuscinervis Mall.

Malloch, 1932, Ann. Mag. Nat. Hist., Ser. 10, vol. X, 301. syn. *Dacus (Dacus) doryloides* Mro., 1939, Jnl. Ent. Soc. S. Afr., I, 32.

It is unfortunate that when describing the species as *doryloides* Malloch's name was overlooked. In the description nothing is said of



Fig. 1. *Dacus (Dacus) fuscinervis*
Mall. ♀.

the frontal bristles, and the specimen has already been returned to the British Museum. However, Dr. John Smart has kindly examined it and writes that there is no trace of any of the frontal bristles — whether these bristles are quite absent in the species only further specimens will show. That they may occasionally be present as minute, hair-like bristles is possible as is the case in *Dacus (Afrodacus) nigriovenatus* Mro. in which normally only a moderate pair at the base of the antennæ is to be seen, with rarely an upper, minute pair of inferior orbitals. The inner scapulars are also present and are about as large as the outer. The photograph (fig. 1) shows the specimen that was described as *doryloides*.

***Ceratitis (Ceratitis) malgassa* n. sp.**

It is curious that only a few species of Trypetidæ have been recorded from the island of Madagascar, an area in which, from its geographical position, may be expected to occur forms of importance in the study of the distribution of these flies. It is therefore interesting to record a new species of Ceratitine Trypetid from there.

The species is very like *Ceratitis catoirei* Guér. that is found in Mauritius and is recorded from the Seychelles, but which as far as is known does not occur on the continent of Africa. However, as has been recorded, fruits from Mauritius infested with the larvæ have been intercepted at the port of Durban.

Holotype, a male obtained by Mr. G. A. Hepburn, entomologist at the Cedara School of Agriculture, Natal, at Tananarive, Madagascar, during his visit there in April 1935.

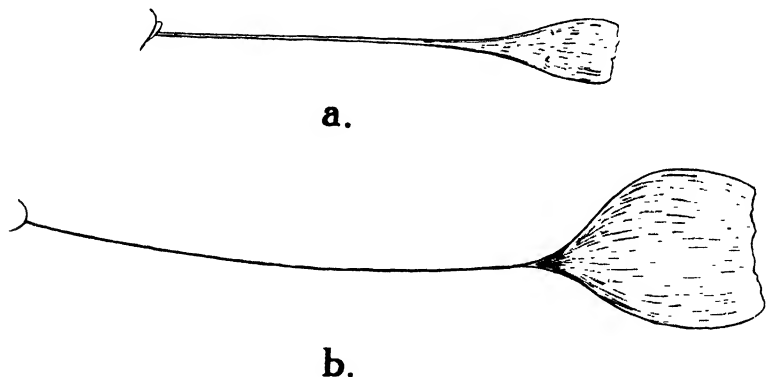


Fig. 2. Spatulate bristle on frons of male of a. *Ceratitis malgassa* Mro., and b. *Ceratitis catoirei* Guér.

The new species may be at once distinguished from *catoirei* by the size and shape of the spatulate bristle on the frons in the male. In *catoirei* these bristles (fig. 2b) are conspicuous, even to the naked eye, as rather large, white spots well in advance of the head as, in what is apparently the normal position, they are directed forward and a little upwards and outward. The bristles are about one and a half times the length of the head and extend beyond the aristæ. The yellowish stem is flattened laterally and the spatula spread horizontally and thus conspicuous in a dorsal view. It is probable that the flat surface of the spatula is morphologically the same as that of the stem and has been twisted through 90 although as far as can be observed there is no sign of a twist at the juncture. Thus too, in a dorsal view as seen in the figure, the stem appears as a fine line,

while laterally it is wide and the spatula seen on edge. The latter, scutiform in shape with the truncate, anterior margin a little concave, is almost transparent and has a strong white reflection by incident light; the surface is rather obscurely striate. In *malgassa* the bristles (fig. 2a) are not so conspicuous, only as long as the head and not projecting beyond the aristæ. They are somewhat displaced in the specimen, but are apparently flattened laterally; the transparent, glassy stem, narrow at the base, is barely widened on its inner two-thirds, then rather more strongly, the edges thickened; the spatula, somewhat wider than the end of the stem, is almost square and rather small. It is also marked with striations that extend faintly on to the outer end of the stem, and is white by reflected light. As seen in the figure the flat surface of the spatula is on the same plane as that of the stem, but the bristle is apparently somewhat twisted outwardly. It may be noted here that in *Ceratitis capitata* Wied. the spatula is lozenge-shaped, the outer end at times more rounded; it is black and strongly striated.

Apart from the spatulate bristles, *malgassa* is very like *catoirei*. Length 5.5 mm., of wing 5.25 mm. Head yellow; the frons appears more prominent than in *catoirei* in which it is usually more flat; there is slight black pubescence, bristles normal, the two inferior and the upper superior orbital dark yellow, the strong ocellars black (usually yellow or only blackish in *catoirei*), the lower, spatulate, superior orbital on a small tubercle; lunule small; antennæ dark yellow, about half length of face, arista bare but slight pubescence on yellowish base; face pale yellowish, flat, epistome not projecting; proboscis and flat palpi yellow. Thorax; the dorsum has a somewhat different appearance to that in *catoirei*, the spots, of which the arrangement is similar, are brownish-black with black pubescence, the supra-alar spots deep black, the spaces between are mainly brownish with whitish dust and pale pubescence, on each side is a somewhat elongate spot over the suture, the strong prescutellar yellow spots form hooks one on each side of and united to a short median yellow stripe that reaches to the dorso-central line; humeri whitish with a brown spot. In *catoirei* the dorsum is almost quite black, the spots, with black pubescence, defined by the pattern of the grey tomentum with pale pubescence, the lateral sutural spots weak and the prescutellar spots usually reduced as also the median stripe, but they are sometimes almost as strong as in *malgassa*. The scutellum is similar in both but in the *malgassa* specimen the basal pair of black spots is strong and the transverse yellow bar well marked, in *catoirei* they are usually weak and so the scutellum more completely black. The pleura are yellow with whitish pubescence, deep yellow on lower mesopleura; on the upper half of the mesopleura is a dull, blackish rectangle (continued a bit towards the base of the wing)

and marked out by wide, whitish margins, only the upper portion of which, on the notopleural line, is usually conspicuous in *catoirei*; upper part of post-scutellum shining black, the lower thickly grey dusted. Bristles normal, inner and outer scapulars yellowish, others black, one mesopleural, the dorso-centrals a little behind line of anterior supra-alars, no distinct propleurals. Legs as in *catoirei*, yellow, with yellow clothing, the front femora also rather swollen and with similar, long, deep, yellow hairs and row of almost orange bristles below. Halteres yellow. Wing as in *catoirei*, basal streaks as usual, basal band yellow above with blackish edges and blackish below, the free marginal band yellow in marginal and submarginal cells with the usual four black spots and black edges, blackish outwardly, cubital free, medial united, both blackish. Venation normal, third vein rather sparsely setulose to middle of first posterior cell, lower, outer angle of discal cell acute. *Abdomen* brownish yellow, broadly blackish with dark greyish dust on hind margin of second segment, the fourth segment almost wholly so and a trace on third; pubescence shining, black. Genitalia yellow.

PERILAMPSIS, Bez.

In view of the discovery of the female of *Perilampsis diademata* Bez. as recorded in the following pages, it is necessary to amend the tables given on page 34 of volume I of this Journal. The changes to be noted are: —

15 (16) No yellow or white hypopleural spots.

- A. Base of ovipositor short, about one-sixth wing-length; abdomen not strongly red, but more reddish-brown, the transverse bars of white pubescence somewhat more pronounced ♂♀ *curta* Mro.
- B. Base of ovipositor long, one-third wing-length; abdomen quite red, the white transverse bars less prominent (♂)♀ *diademata* Bez.

16 (15) Yellow hypopleural spots present.

17 (18) A single reduced spot.

- A. Abdomen red; squamæ blackish (if hypopleural spot is but little apparent or absent, see 15(16) B) ♂ *diademata* Bez.
- B. Abdomen blackish-brown with yellowish transverse bands; squamæ white ♂ *miratrix* n. sp.

20 (19) Yellow mesopleural stripe widened; basal band on wing close to anal cross-vein, only hyaline streaks present; base of oviposition half length of wings ♀ *miratrix* n. sp.

Perilampus diademata Bez.

Bezzi, 1924, Ann. S. A. Mus., 19, 482, Pl. XII, fig. 28; Bull. Ent. Res., 15, 104 (in tables).

Munro, 1926, Union S. Afr., Dept. Agric., Ent. Memoir 5, 23; 1939, Jnl. Ent. Soc. S. Afr., 1, 39.

As has been noted previously, no authentic females of this species (particularly from the type locality) were known, but in 1929 I recorded a pair from Bulawayo, Southern Rhodesia, that was, with some confidence, regarded as *diademata* Bez. However, efforts were made as occasion offered to secure more specimens at or near the type locality, but without success. It was not till 1937 when species of *Perilampus* were bred by Mr. W. E. Marriott and the writer from fruits of species of *Loranthus* (apparently a group food-plant for the genus) that further definite steps were taken. During 1938 Mr. F. A. S. Turner who is in charge of the Buffelspoort Citrus Experiment Station kindly collected numbers of fruits of a *Loranthus* growing there and from these several specimens of both sexes of *Perilampus diademata* emerged. Comparison of the females showed at once that the Rhodesian pair could not be *diademata*.

Apart from the lack of sufficient material on which a comparative examination could be made, the chief reason for regarding the Rhodesian pair as *diademata* was that the single type, a male, of *diademata* appeared to have been more or less teneral at the time of capture. There was thus nothing to indicate to what extent the bright red, translucent abdomen might not have darkened in more mature specimens, and so have assumed the darker, more blackish, appearance seen in the Rhodesian male, the two males being otherwise very similar.

Five males and twelve females emerged from the Buffelspoort material and these were kept alive, being fed on sugar and water, for three weeks. There was therefore every reason to believe that the coloration was fully developed and the integument thoroughly hardened when the specimens were pinned. In all the abdomen remained a bright red and, when held to the light, was translucent. Further, in the dried specimens the abdomen is still red, and in better preserved ones, even somewhat transparent. The males are the same size as the type (length and wing-length 4.0 mm.), the females rather larger, length 5.5 mm., of wing 4.5 mm. In the male the frons is about one-fifth longer than wide, in the female barely longer; in the type the third joint of each antenna has been broken off, in the fresh specimens they are dark yellow, the arista shortly pubescent; the reddish-brown band over the top of the face and base of antennæ is wider in the female, reaching nearly to the middle of the face; in the female the femora are a darker brown than in the male. In the type there is a single, fairly distinct, yellow spot on the

hypopleura, while in the fresh males there is perhaps just a bare trace of yellowness there, in the females none at all. The abdomen in both sexes has a striking red colour, translucent in live specimens, more or less transparent when dry; the rather inconspicuous transverse bands of white pubescence are on the hind margin of the second and fourth segments, not of the first and third. The base of the ovipositor is shining black, with black pubescence; it is legging-shaped and but a little shorter than the pre-abdomen — about one-third the wing-length.

In life the eye is marked with three horizontal bars of shining green on a chocolate-coloured ground. The top bar is opposite the two inferior orbital bristles and about as wide as their distance apart; it is constricted a bit in its middle and then narrows to a point before reaching the hind edge of the eye. The middle bar is narrow and is just below the roots of the antennæ. The lowest bar is opposite and, in front, as wide as the lower white portion of the face narrowing rapidly to a point at the middle of the hind margin of the eye.

Biology.

Fruits of the host-plant, *Loranthus rubromarginatus*, were collected by Mr. Turner on the Buffelspoort Citrus Experiment Station, near Marikana in the Transvaal. The locality is some twenty-five miles to the west of the spot at Silikatsnek where the type of *diademata* was taken. From experience with other species of *Perilampus* that had been bred, the collecting was delayed until the berries were beginning to ripen. However, in the material gathered were many dried-up, shrivelled and blackish fruits, and it was in these and not in the ripening fruits that the puparia were found. A few of the infested fruits had become reddish, but this was probably due to premature ripening because, on comparison of their size and that of greener infested fruits with fully ripened ones, it seems that infestation must occur when the fruits are green and little more than half grown.

Examination of the available material showed that the larvæ feed in the seed and not in the outer, and later soft, ripe parts of the fruits. The puparia were found in the old fruits embedded in a dirty brown mass mixed with latex, an exit having been made by the larva. The large, red, ripe fruits are much eaten by birds, but as infestation by this species is in the green fruits which seldom ripen, the insect is not interfered with by being incidently eaten by the birds.

The puparia have the typical obliquely-truncate anterior end common to other species of the genus.

Perilampus curta Mro.

Munro, 1938, Jnl. E. Afr. & Uganda Nat. Hist. Soc., 13, 164.

Comparison of a female paratype of this species with the newly

discovered females of *Perilampus diademata* shows that the two are closely allied. The females may be distinguished by the lengths of the base of the ovipositor, about one-sixth the wing-length in *curta*, one-third in *diademata*. The males may be more difficult, but the very red abdomen of *diademata* seems to be quite characteristic. In the description of *curta* it is stated that the abdomen is strongly reddish; this must be accepted as comparative to the other species in which it is blackish. In the female paratype it is a rather light, reddish-brown; no male is available for further comparison.

A note may be made here of an error in the original description. It is stated „A species very like *dimidiata*” — this should read „*diademata*”.

***Perilampus miratrix* n. sp.**

Perilampus diademata Mro. nec Bez., 1929, Bull. Ent. Res., 20, 394; 1939, Intl. Ent. Soc. S. Afr., 1.39 (in part).

As has been explained, the pair recorded above in 1929 as *diademata* and an additional female, are a distinct species. The main characters that may be noted are the strong double white hypopleural spots in the female, and in both sexes the white, not black, squamæ, and the abdomen of the more usual blackish-brown colour with rather pronounced, transverse, yellow bars.

Holotype ♂, Bulawayo, S. Rhodesia, 19.1.27, allotype ♀, 24.7.27 and paratype ♀, 1.5.27, R. H. R. Stevenson.

♂. Total and wing-length, 4.0 mm. *Head*: occiput mainly yellow, with a rather reduced pair of brownish spots on each side above neck; frons, upper third yellow and a brownish bar at level of lower superior orbital bristle, the lower two-fifths whitish, two inferior orbitals, the ocellars strong; lunule inconspicuous; antennæ brown, arista short pubescent; face: a brown bar over upper third and base of antennæ, white below, genæ with a large brown spot; proboscis and palpi brownish. *Thorax*: blackish-brown with a tinge of reddish; dorsum: pubescence black and the usual pre- and post-sutural bars of white pubescence with white dust; dorso-central bristles on line of anterior supra-alars, one mesopleural. Humeri and united broad mesopleural stripe and scutellum ivory white, on hypopleura a small, rather indistinct, yellow spot; four scutellar bristles. Legs brown, the fore tibiæ paler and all tibiæ and tarsi yellowish. Wing as in *diademata*; medial bar united, cubital free, the basal and humeral separated by hyaline streaks and the costal cells mainly hyaline. *Abdomen*: black, the third segment entirely so, second broadly yellowish on hind margin and with narrower silvery bar and pale pubescence; fourth on anterior third and sides, yellowish in middle and wide silvery bar and pale pubescence on hind margin, fifth yellow on middle.

♀. Length 5.25 mm., wing 4.3 mm. Similar to male. Thorax black and there is an elongate, curved, double, white hypopleural spot in addition to the other white marks. Middle and hind femora black, the front pair with a black stripe below, yellowish above, tibiæ and tarsi yellow. Abdomen black, the second segment with a moderate silvery dusted hind margin, the fourth on the hind two-thirds. Base of ovipositor elongate legging-shaped, shining black, with black pubescence, nearly twice as long as pre-abdomen and about half the wing-length.

MARRIOTTELLA n.g.

The position of this genus seems to be a rather intermediate one, but it is perhaps most closely allied to the Euribiini (*sensu* Hendel 1927). It may be located there, at least provisionally, until a revision can be made of the African species that may be placed in that group or are related to it. If Hendel's 1927 tables were strictly followed, this new genus would come somewhere in the neighbourhood of the Tephrellini, at least as regards the appearance of the abdomen; it may be more nearly allied to *Ensina* on account of the single superior orbital bristle, but *Ensina*, it may be noted, has been regarded as allied to the Euribiini. Further, *Gymnosagena* Mro. is in a somewhat similar position to *Marriottella*.

The new genus may be considered as agreeing with the Euribiini in its general configuration, the shape of the head, the single superior orbital bristle and the wing-venation. Two characters seem to exclude it as the group has been defined by Hendel, namely, the white occipital bristles and only two scutellar bristles. As regards the relative lengths of the fifth and sixth tergites of the abdomen in the female, this seems to be a rather unreliable character. In *Mariottella* the sixth is only a little longer than the fifth while in most species of *Myiopites* and *Euribia* known to me it seems to be definitely shorter; however, in female specimens of two European species, *Myiopites blottii* Bréb., and *Euribia maura* Frf. the sixth is almost twice as long as the fifth.

The chief generic characters of *Marriottella* are: — *Head*: occipital bristles white, a single superior and two inferior orbital bristles, the ocellars well developed, frons bare, lunule moderate, antennæ rather elongate, the third joint broadly acuminate, arista short pubescent, proboscis short. *Thorax*: chaetotaxy normal, dorso-central bristles close to suture, one mesopleural and two scutellars. Wing narrow, pattern reduced, a conspicuous white spot at tip, third vein bare, upper cross-vein well beyond middle of discal cell, anal cross-vein straight.

Genotype: the following new species, *Marriottella exquisita*.

Marriottella exquisita n. sp.

Holotype ♂, allotype ♀, 20♂, 17 ♀, paratypes, Drakensberg, Natal (Rockerries Section) July 1938, W. E. Marriott. Reared from puparia found in terminal twig galls on *Helichrysum splendidum*.

Length ♂ 4.0 mm., of wing 3.3 mm. (width 0.9 mm.), ♀, 4.5 mm., of wing 3.5 mm. (with 1.0 mm.). A black, ant-like species with just enough light, whitish dust over the whole body to give a light, greyish appearance over the black, the tibiae and tarsi mostly brown. *Head* (fig. 3): occiput hollow above, moderate below, the bristles white; frons as long as wide, slightly narrowed anteriorly where it is a little prominent in profile, flat and bare, most

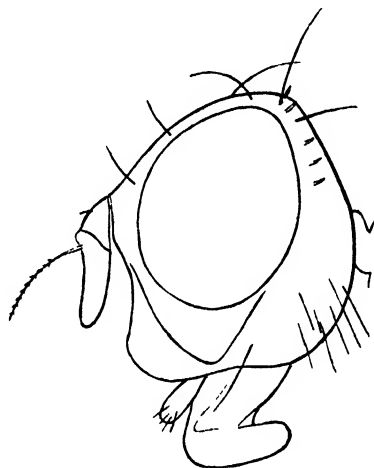


Fig. 3. *Marriottella exquisita* n. sp. Head.

of the central part with a slight reddish-brown tinge, one superior orbital bristle (in one specimen there is on one side an upper white bristle), two inferior orbitals; lunule moderate; antennæ rather light reddish-brown with a slight blackish tinge, as long as face, third joint acuminate in its whole length, but the tip rounded, arista concolorous with antennæ and short pubescent; face rather wide, broadly raised in middle to moderately prominent epistome, the edges of which are polished; cheeks about a third the width of widest part of third antennal joint, genæ rather less than one-fifth height of eye, the bristle moderate; palpi flat, black, proboscis short, but hooked, brownish.

Thorax: slight, fine, black pubescence and a few white hairs along front edge of dorsum; bristles normal, dorso-centrals close to suture, mesopleural, pteropleural and sternopleural present, two

scutellars. Scutellum short and broadly rounded at end. Legs: coxæ more or less brownish, as also femora at outer ends, fore tibiæ mostly brown, the others broadly so apically, all metatarsi brown, the other hind tarsal joints black, all the rest black above, brown below. Wing (fig. 4) rather short, but narrow, in the male the inner margin almost straight, in the female more convex; the black bar from base to end of stigma is very dense, the rest of the costa and all veins beyond the line of the end of the stigma are black, within this line and below the black basal stripe, the wing membrane and the veins are yellowish; the blackish band before the wing tip is very irregular, in the figure it is strongly marked, otherwise it becomes narrowed below and sometimes does not cross the fourth vein. A most noticeable feature is the white patch filling the wing tip and bounded inwardly by this black band; on this patch the

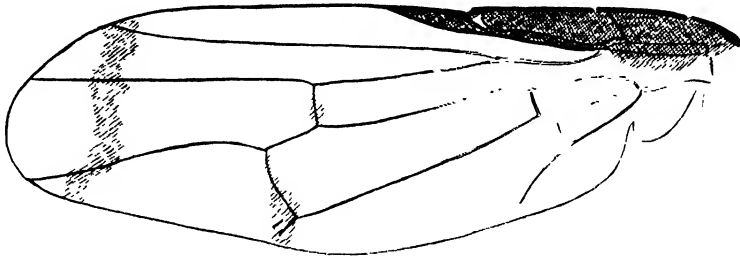


Fig. 4. *Marriottella exquisita* n.sp. Wing.

microtrichiæ are colourless and it would seem that they are filled with air which serves to give the milky white effect — on the triangle between the membrane folds and the costa at the end of the first posterior cell they are much denser and the whiteness is thus more pronounced there. At the base of the wing, on the yellowish membrane, there are also spots on which the microtrichiæ are colourless, but the white effect is not apparent on them. On the rest of the wing surface the microtrichiæ are black, giving the wing a very slightly greyish appearance and the presence of stronger, very black, microtrichiæ along the membranous edge of the hind margin of the wing simulate a very narrow black edging. Third vein bare. Upper squama white on its outer two-thirds, and with a white fringe, the lower brownish and narrower than the upper. Halteres reddish at base.

Abdomen: the light greyish dust is rather less than on thorax. Dorsum at base with slight darkish pubescence, otherwise covered with rather sparse, but long, somewhat erect, thickish white pubescence. Venter: sternites narrow, shining black with slight, fine, black pubescence; membranes large, dull black; genitalia rather

large, shining black. Base of ovipositor shining black with black pubescence, 1 mm. in length, rather more than a fourth of the wing-length; it is stout, rather short and flattened, the width at base about half the length.

Puparium. Length 3.25 mm., the greatest width 1.7 mm.; oval, slightly or sometimes more markedly narrowed anteriorly; polished black, dull on ventral surface, the segmentation rather strongly marked by greyish etching.

Biology.

The flies described were reared from puparia in terminal twiggalls on *Helichrysum splendidum* (Thbg.) Less. *) found in the Rokeries Section of the Drakensberg in Natal. The material was collected by Mr. W. E. Marriott in July 1938 along the banks of the

Ntonyelana River (puma kwelanga). Mr. Marriott said that the Zulu words „puma kwelanga”, meaning where the sun rises, indicate that the river comes from the east, flowing west; they serve to distinguish this river from another Ntonyelana River that flows east and to which are added the words „shona kwelanga”, that is, where the sun sets. Further, Mr. Marriott wrote: „The plant seems to be confined to rivers and grows amongst boulders on banks which may be flooded after storms. Galls were found chiefly on the large well-grown bushes. Along some of the rivers there are no galls on the bushes; this may be a matter of aspect for, owing to the proximity of high peaks, some streams get much less sun than others, thus these less sunny places do not seem to be frequented by the flies.

The Gall. At first sight the gall appears to be of fair size, about 15 mm. long and 10 mm. in diameter. On examination, however, it is



Fig. 5. *Marriottella exquisita* n.sp.
A gall at the tip of a twig of
Helichrysum splendidum.
(Enlarged twice.)

*) Kindly determined by Miss I. C. Verdoorn of the National Herbarium, Pretoria.

found that the outer portion consists of a close-set, imbricate series of leaves enclosing what is really the „gall”, a relatively small swelling at the tip of the twig which is only slightly if at all thickened. It would seem that the egg is laid in the extreme tip of a young growing shoot, and the larva remains there, not boring down into the stem. The presence of the larva, however, while preventing any further growth in length of the stem, causes as a rule a slight swelling and a vigorous development of leaves. These become bract-like and much wider than the linear leaves found on the plants of *Helichrysum splendidum* occurring in this area. As they develop the leaves close over the tip of the twig, resulting in the appearance seen in the photograph (fig. 5).

***Oedaspis (Tylaspis) crocea* n. sp.**

Differs from the other two species of the subgenus in wing-pattern and in the black dorsum of the thorax.

Holotype ♂, 25—30. X. 1928, allotype ♀, 1—6. XI. 1928, Cape Province, Matjesfontein, R. E. Turner. Types in the British Museum.

♂, length, 5.0 mm., wing, 4.25 mm., ♀, length, 6.0 mm., wing, 4.5 mm. *Head*, yellow, swollen (rather crushed in specimens), the eye small and frons prominent, occiput flat above, moderate below,

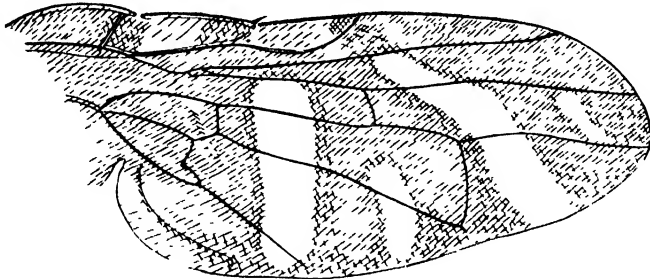


Fig. 6. *Oedaspis (Tylaspis) crocea*, n.sp. Wing.

where there is golden sheen; frons wide, about two-thirds width of head, three-fourths long as wide; bristles black, occipitals whitish, four inferior and one superior orbital, the female with a second, yellowish superior orbital on one side, ocellars moderate, the male with a supernumerary pair, before lunule a little, but strong, black pubescence and a distinct pair of hairs a little before and on inner side of the superior orbitals; lunule large and wide, rather short; antennæ two-thirds length of face, second joint about as large as the small third which is only a little longer than wide, arista brown, bare; face with shallow grooves, epistome a little prominent; cheeks as wide

as third antennal joint, genæ twice this width and about one-fourth height of eye; eye rather oblique, twice as long as wide, rather longer and more oblique in female; short proboscis and palpi too retracted into mouth cavity for observation.

Thorax yellow; dorsum black, chestnut on sides above humeri, along suture and a supra-alar stripe also on hind fourth with obscure median and dorso-central streaks to suture, in female only a narrow transverse bar just before prescutellar bristles, which in male are on black spots; pubescence coarse, yellow, longer behind, on the black faint whitish dust, except laterally; sides of thorax also with rather long, coarse, yellow pubescence; pleura with blackish tinge, mesosternites broadly black centrally; bristles normal, black, no scapulars, dorso-centrals on line of anterior supra-alars, pteropleurals obscured by pin. Scutellum with emarginate hind margin, yellow with pair of moderate lateral shining black spots and large, rounded apical pair, four bristles on the black; a little coarse pubescence; upper part of post-scutellum yellow, lower black; halteres and legs yellow; wing (fig. 6) stigma yellow hyaline, apex brownish, the dark bands are so extensive that the wing is almost entirely yellowish-brown, only relatively narrow, hyaline bars remaining, these being blackish margined and the hind part of the wing also with a blackish tinge; the figure is of the female, in the male the small outer streak is absent, the small medial one reduced to a spot on the hind margin. *Abdomen* yellow with black, yellow-shining pubescence; venter yellow with black pubescence; genitalia dark yellow; in the female the last two segments slightly blackish on middle, sixth about three-fourths length of fifth; base of ovipositor short, truncate conical, broad at base, 0.9 mm., a little shorter than fifth segment, chestnut, black at tip.

***Paroxyna clarinetta* n. sp.**

Very like *Paroxyna anceps* Lw., but larger, wing-length 4.5 mm.; in *anceps*, 3.5 to 4.0 mm. varying to 2.75 mm. in the smaller specimens of the variety *fasciolata* Bez. The banded wing-pattern is rather more strongly marked than in *anceps*, but in the variety it is again stronger, the third, outermost, hyaline spot in the marginal cell more usually absent. The chief differences from *anceps* are the much longer base of the ovipositor, and the long, coarse, white pubescence on the dorsum of the abdomen. This applies particularly to the female, as the only male available of the new species is in poor condition.

Holotype female, allotype male and seven female paratypes, Cape Province, Matjesfontein, October-December 1928, R. E. Turner; one female paratype, Little Karroo, 38 miles east of Ceres, XI. 1924, R. E. Turner (British Museum material). One female paratype, Cape

Province, Bloukrans, near Calvinia, 17. XI. 1931, J. Ogilvie (from the Imperial Institute of Entomology, London).

♀. Length 6.5 mm., of wing 4.5 mm. *Head* yellow, as long as high and a quarter wider, of normal shape; frons deeper yellow, whitish on sides and a slight median stripe, bare, bristles black, three inferior orbitals, two superior, the upper whitish as also verticals, the occipitals darkened; lunule moderate; antennæ nearly as long as face, darker yellow, third joint brown, arista microscopically pubescent; epistome slightly projecting, cheeks as wide as third antennal joint, as also genæ; lower part of head with coarse, yellowish hairs among which genal bristle barely differentiated; palpi very elongate, setulose, brownish on outer half; proboscis very elongate, labellæ as long as base and one-fourth longer than head. *Thorax* black, humeri, narrow notopleural stripe and wing-base yellow, generally covered with moderate, whitish dust and on dorsum a slight median and stronger dorso-central brownish stripes uniting before scutellum; pubescence coarse, whitish; bristles normal, black, pteropleural yellow, dorso-centrals close to suture, four scutellars, apicals about half length of basals. Legs normal, light brownish, femora black except on outer sides. Halteres yellow. Wing banded, a faint basal band, stigma yellow on inner two-thirds, blackish at end, a bar from stigma over upper cross-vein to top of lower then over outer end of discal cell to wing margin, a weak bar from middle of discal cell faintly to wing margin, a bar from tip of marginal cell to hind margin with a hyaline spot in marginal cell, occasionally absent or with one in submarginal cell as well, apical band from tip of submarginal to tip of second posterior cell. *Abdomen* black with slight white dust and long, white pubescence; base of ovipositor very long, rather more than twice length of abdomen and 0.6 times length of wing, narrow, widened at base where in dry specimens it is usually flattened and apparently about as wide as last segment; shining black with black pubescence.

♂. Length 4.25 mm., of wing 3.75 mm. The single male is damaged and in poor condition, but apparently like female. It is, however, almost impossible, without better specimens, to indicate its distinguishing characters especially from larger males of *anceps*. In the specimen the abdomen is black with slight white dust and the genitalia shining black.

On certain South African gall-forming Trypetidae (Diptera), with descriptions of new species

by

H. K. MUNRO

In studying the species of African Trypetidae that have been placed in the genera *Afreutreta* Bez. and *Parafreutreta* Mro. it has become necessary to consider to some extent their wider relationships. Two groups of genera appear to be concerned, including some from the palæarctic region, others from North and South America. Allies among the South American genera in particular are of interest, as the African forms have been considered less related to them and more to the oriental, particularly Indian, genera.

For practical purposes the two groups are separated chiefly on the wing-pattern. They are those indicated by Hendel *) in couplet 23 of his tables of the South American genera, and also in his tables **) of the palæarctic Trypetidae, although in a somewhat different manner. Several anomalies exist, however, and these can only be elucidated after a much closer study of the sub-families and tribes that have been recognized.

Group I. Genera in which the wing-pattern is formed of more or less transverse bands, which may in some cases tend to disappear, but, according to Hendel, is never reticulate nor hyaline-spotted. The sixth tergite of the abdomen in the female is as a rule shorter than the fifth, but in some species approaches the same length. The occipital row of bristles is typically black, but may be whitish or white, and flattened, the difference in the colour and appearance of this row of bristles having been considered by Bezzi as a character of sub-family value. There may be one or two superior orbitals.

The genera concerned are: — *Oedaspis* Loew, with Hendel's two sub-genera *Melanoedaspis* and *Dichoedaspis*, and *Ptiloedaspis* Bezzi from the palæarctic region, *Cecidochara* Bezzi and *Procecidochara* Hendel from America, and *Tylaspis* Muro from South Africa. The genera are all much alike, forming a compact group that may well be included in the Trypetinae, tribe Trypetini, as recognized by Hendel (op. cit. 1927).

The group has been mentioned in order to help in an understanding of the one which follows, and also of the new genus *Acron-*

*) Hendel, 1914, Die Bohrfliegen Südamerikas. Abh. u. Ber. K. Z. Mus. Dresden, xiv, pp. 6—8.

**) Hendel, 1927, in Lindner, Die Fliegen der Pal. Region, 49. Trypetidae, pp. 19—20.

neus described later. It may perhaps be best regarded as a related, but parallel, series of genera.

Group II. In the genera included here the wing-pattern is reticulate or hyaline-spotted, even if bars or bands are apparent. The genera immediately concerned are *Eutreta* Loew and *Strobelia* Rondani from America and the South African *Afreutreta* Bezzi and *Parafreutreta* Munro. The systematic position is somewhat uncertain and may be anomalous. The chief difficulty arises in regard to the relative lengths of the fifth and sixths tergites of the female, a character considered of great sub-family value by Hendel. In all the species, except as will be noted later, the sixth is at least slightly shorter, and thus the genera should be included in Hendel's Trypetini. However, from a broader viewpoint and on account of the wing-pattern, they may remain provisionally in the Tephritinæ and they may be considered allied to the Dithichini a has been previously suggested. *).

Biology. As far as is known all the species of both groups are gall-forming, and all host-plants belong to the Compositæ. In some genera, as in *Parafreutreta*, the species seem to confine themselves to one genus of plants, that is species of *Senecio*, but in others this is not the case. As regards species that have not been reared, it may be surmised that they are also galligenous, although this may not necessarily be so. It does seem, however, that to some extent allied species may be expected to show similar biological habits.

Table of African Genera and Species of Group II.

- | | | |
|--------|--|------------------------------------|
| 1 (2) | Wing hyaline, third vein bare, one superior orbital bristle, a peculiar point at tip of third antennal joint | <i>Acronneus</i> n.g. |
| | | <i>A. bryanti</i> (Mro.) |
| 2 (1) | Wing not hyaline, yellow or more or less dark, with reticulate or hyaline-spotted pattern, third vein setulose, two superior orbitals and no point at tip of third antennal joint. | |
| 3 (14) | Wing uniformly dark with numerous, small, hyaline dots with white microtrichia; a black spot at base of antennæ . . . | <i>Afreutreta</i> Bezzi |
| 4 (5) | Wing of usual shape, second basal cell not dilated, lower squama linear. | <i>Afreutreta bipunctata</i> (Lw.) |
| 5 (4) | Wing broadened, the second basal cell more or less enlarged; lower squama ear-like. | |
| 6 (7) | A conspicuous, sub-apical, transverse, hyaline bar on wing | <i>Afreutreta bevisi</i> Mro. |
| 7 (6) | No such hyaline bar. | |
| 8 (9) | A large, paler, yellowish area on middle of wing | <i>Afreutreta discoidalis</i> Bez. |
| 9 (8) | Wing almost or quite dark, brown or blackish, with hyaline dots. | |

*) Munro, 1929, Bull. Ent. Res., xx, 395.

- 10 (11) Wing uniformly blackish with the hyaline dots fairly evenly scattered all over, but rather larger towards the hind margin; abdomen not spotted *Afreutreta frauenfeldi* (Schin.)
- 11 (10) Wing brown, a row of hyaline spots around costa and hind margin, the tiny white-hyaline dots confined to fore part of wing below the third vein grading into larger, sub-opaque, yellowish spots that almost form a reticulation; on the fore half also a few larger, conspicuous, blackish-brown spots; abdomen spotted.
- 12 (13) The apical marginal hyaline spot extends between ends of third and fourth veins; discal „ocellar” spots (certain of the paler, yellowish spots that have a white-hyaline centre) more numerous. The third vein is stated to be bare, but is probably setulose as in the variety which follows *Afreutreta millepunctata* (Bez.)
- 13 (12) The apical hyaline spot extended from third vein nearly to fifth, or to half-way between fourth and fifth, with an additional hyaline spot before the fifth; „ocellar” spots less numerous (teste Bezzi) *Afreutreta millepunctata* (Bez.) var. *limbatella* Bez.
- 14 (3) Wing pale to yellow with more or less extensive, pale to dark reticulation forming moderately to well-marked bars (costal, submedian and apical), never with white-hyaline dots; no black spot at base of antennæ *Parafreutreta* Munro.
- 15 (24) The hind half of base of wing paler and a distinct more or less hyaline, transverse, sub-apical bar separating an apical, darker bar from that over the lower cross-vein, bar along inner portion of costa may be weak.
- 16 (19) Smaller species, 4.0 mm. (The abdomen not blackish). The pattern is always formed of a distinct and fine reticulation as pronounced in marginal cell as elsewhere; the wing-bands well-marked, the inner basal portion of wing and the outer portion of second posterior cell paler. In the females the sub-apical, hyaline bar is formed of a row of large, well-defined spots, usually one each in the marginal, submarginal and first posterior cells, the second posterior more or less hyaline; in the males the row of hyaline spots is only rarely pronounced, the separation of the apical dark bar and that over the lower cross-vein being caused by generally larger reticulation. Frons curved in profile and fronto-facial angle not marked; epistome not at all upturned.
- 17 (18) Third antennal joint rounded at end, arista bare, or only microscopically pubescent at base *Parafreutreta conferta* (Bez.)
- 18 (17) Third antennal joint with the upper corner distinctly angular; arista microscopically pubescent (at 100 x) *Parafreutreta foliata* n. sp.
- 19 (16) Larger species, 4.5 to 6.5 mm. The dark bars less defined being formed a coarse, broken-up reticulation none being defined in the marginal cell.
- 20 (21) Frons entirely covered with coarse, pale pubescence; two or three inferior orbital bristles; antennæ half length of face and relatively small; wing almost entirely brownish-yellow, the bands more conspicuous macroscopically; upper cross-vein about its own length from lower *Parafreutreta hirta* n. sp.
- 21 (20) Frons with only moderate pubescence in middle; antennæ longer than half the face.
- 22 (23) Two inferior orbitals; antennæ about three-fourths length of face; third joint with a slight, obtuse point at end; third vein setulose to beyond upper cross-vein, which is its own length from lower; first posterior cell not widened outwardly; very like *hirta* and of same size, but wing-pattern rather more reduced *Parafreutreta hirta* Mro. var. *felina* var. n.

- 23 (22) Three inferior orbitals; antennae about two-thirds face, third joint rounded at end; third vein setulose to upper cross-vein with is five-eighths its length from lower; first posterior cell somewhat widened outwardly; pattern barely reticulate, the subapical bar wide and mainly yellow hyaline . . . *Parafreutreta pondoensis* n. sp.
- 24 (15) No subapical, hyaline or subhyaline bar, only the inner basal half of wing and outer part of second posterior cell paler, the costal bar thus runs broadly to end of wing and down over lower crossvein.
- 25 (26) Wing with strongly marked bars; arista practically bare; frontal pubescence short . . . *Parafreutreta pretoriae* Mro.
- 26 (25) Wing with an almost uniformly pale reticulation, the bars just perceptible; arista microscopically pubescent; frontal pubescence strong, as also on ocellar dot . . . *Parafreutreta retisparsa* n. sp.

ACRONNEUS n.g.

It seems that this genus should be placed near *Oedaspis* Loew. In view of the shortened sixth tergite in the female and the pointed anal cell, it falls into the Trypetini as defined by Hendel (oP. Cit. 1927) in spite of the while, although pointed, occipital row of bristles. It is further distinguished by the peculiar point at the tip of the third antennal joint, the bare third vein and the hyaline wings. *Head* rather short but much as in *Oedaspis* and the other genera; frons and face moderately prominent, the frontofacial line convex; frons about half width of head, slight pubescence, one superior and two inferior orbitals; lunule rather small; proboscis short. *Thorax*: Dorso-central bristles on line of anterior supra-alars, four scutellars; scutellum not swollen, but more or less straight sided and somewhat convex above; thoracic squama large; wing: costal bristles small; third vein bare; upper cross-vein more than its length from lower; hyaline or faintly infuscated but no pattern; base of ovipositor short.

Genotype: *Parafreutreta bryanti* Mro.

Acronneus bryanti (Mro.)

Munro, 1930, Bull. Ent. Res., XX, 398, Pl. XV, fig. 6; 1929, Union S. Afr., Dept. Agric., Ent. Memoir 6, 15 (*Parafreutreta*).

Since the first record of this species when only the female was described, a male was reared from a puparium in a gall collected at Prieska in July 1931 by Mr. E. G. Bryant, and in May-June 1939 flies were reared from galls collected by Mr. W. G. H. Coaton on the farm Kalkbank to the north of Pietersburg in the Transvaal. The host-plant in each case was the same as that previously recorded, namely *Senecio* (*Kleinia*) *longiflorus*, and the biology similar.

The male resembles the female, but is smaller (length 3.5 mm., of wing 3.0 mm.) The wing has a distinctly darker tinge, especially towards the base, and the stigma much darker than in the female. In one female there is a third inferior orbital on the one side.

AFREUTRETA Bezzi

Bezzi, 1924, Ann. S. A. Mus., XIX, 527; Bull. Ent. Res., XV, 127. Munro, 1929, Bull. Ent. Res., XX, 395. Genotype: *Trypeta bipunctata* Lw.

In considering this genus various questions arise, some of which cannot be settled without a wider review of several other genera and this must include a comparative study of characters that have been, and others that may be, used in separating the genera and higher groups.

In addition to the genotype, there have been included: — *discoidalis* Bez., *frauenfeldi* Schin., *millepunctata* Bez., *limbatella* Bez., *bevisi* Mro., and *biseriata* Bez. The last is better placed in *Elaphromyia* Bigot.

A closer study leads one to suspect that possibly none of these species is actually congeneric with the genotype, *bipunctata*. One character regarded as important by authors is the relative length of the sixth to the fifth tergite of the abdomen of the female. In all the sixth is slightly to markedly (half) shorter than the fifth, while in *bipunctata* it is slightly longer. (I have not seen *millepunctata*, of which *limbatella* was described as a variety). Then in *bipunctata* the lower squama is quite linear, while in the others it is ear-like and about as large as the upper. This character has not been used extensively, but from tentative studies made so far in species of *Trypanea* and *Acanthiophilus* it seems to be variable. Further, the anal cell is not pointed, although there is a kink in the cross-vein, while in the others the cell is pointed.

Studies on these lines are being continued, but the stronger impression at present is that *Afreutreta bipunctata* is more nearly allied to the *Trypanea-Acanthiophilus* group, especially *A. muiri* Bez. and *A. hemimelas* Bez. At the same time *bipunctata* shows at least a strong superficial resemblance to the American *Eutreta sparsa* Wied. From this it also differs in the three characters noted, but agrees on various points, one being the black spot at each side of the base of the antennæ. The most striking is perhaps the peculiar wing-pattern, the wing being almost black, with numerous, small, hyaline dots each with white microtrichiae; similar spotting is found in the other South African species to a greater or less extent. Such a pattern would place these species in the Tephritinæ according to Hendel, but it need not necessarily mean that all the species in which it occurs are congeneric. It may thus be suspected that a new genus is needed for the other species; it is felt, however, in view of the work in progress, that this may be deferred till a later date. Finally what has been said here must be taken in conjunction with earlier remarks (Munro, 1929) but it may be pertinent to add that, without further study, there seems little against the inclusion of all except *bipunctata* in

Eutreta. It would be of interest also to know more about the other American species placed in *Eutreta*.

Nothing more, apart from what is said in the tables already given, is intended here about the species of *Afreutreta*.

PARAFREUTRETA Munro

Munro, 1929, Bull. Ent. Res., XX, 396.

Genotype: *Camaromyia conferta* Bez.

In the description this genus is rather insufficiently differentiated from *Afreutreta*. The number of inferior orbital bristles is of no importance as they may vary from two to three in one species, but the presence or absence of the black spot at the base of the antennæ, added to similarity of other characters, does seem to be of some group value. It has not been decided what is the exact nature of the spots.

The species included here resemble *Afreutreta discoidalis* and the others, rather than *A. bipunctata*, from which they differ also in the shorter sixth tergite of the female and the ear-like lower squama. In addition to the absence of the black spot at the base of the antennæ, *Parafreutreta* differs from *Afreutreta* in the appearance of the wing-pattern, and because of these constant differences is retained as a separate genus. In regard to the wing-pattern, there seems at present a tendency towards its disuse in generic distinctions. At the same time there can be no objection to its use when due regard is given to others characters, to the nature of the pattern and to its occurrence throughout a group of species. The peculiar, white-dotted appearance and lack of bands or bars in *Afreutreta* is very characteristic. There is nothing at all similar in *Parafreutreta*. Here there are an apical and a median (over the lower cross-vein) dark bar separated by a more or less hyaline subapical bar, and a basal costal bar of greater or less extent, or a broad costal bar from base to apex and extending over the lower cross-vein, in all cases the pattern being reticulate or nearly so, but the hyaline or sub-hyaline spots of the reticulation do not appear as white dots.

Parafreutreta conferta (Bez.)

Bezzi, 1926, Boll. Lab. Zool. Portici, XVIII, 293, Fig. II, C (*Camaromyia*).

Munro, 1926, Union S. Afr., Dept Agric., Ent. Memoir 5, 30; Bull. Ent. Res., XX, 397 — in part (*Parafreutreta*).

A closer examination of the material recorded in 1929 shows that the series of larger specimens from Durban must be regarded as a separate species. The only records therefore for *P. conferta* are those originally made from East London. The host-plant is *Senecio angulatus* on the stems of which galls are formed. It may be noted

that when Bezzi described the species he thought it might be placed in *Afreutreta*.

A certain difference in the wing-pattern between the sexes may be noted. As has been said, the subapical hyaline bar across the wing is formed of a series of spots. In the male it is usually complete right across the wing, but is always narrow and at times interrupted by one or more brown streaks. In the female it is wide and complete, not even interrupted by the reticulation in the second posterior cell, only rarely is there a slight infuscation along the veins.

Puparium. Length 4.0 mm. Shining yellow, opaque, the anterior end darkened, sometimes brown or almost black. The lower surface is straight or slightly concave, the upper strongly arched, the hind end well rounded. In a lateral view it is practically symmetrical on the short axis, the long axis being curved upwards.

***Parafreutreta foliata* n. sp.**

A reddish-yellow species very like *conferta*, differing in the angular end of the third antennal joint, the minutely pubescent arista and somewhat in the wing-pattern.

Holotype ♂, allotype ♀ and a pair of paratypes, St. Lucia Lake, Zululand, September 1938, W. E. Marriott; 7 male and 7 female paratypes, Moseley (near Durban), Natal, September 1938, W. E. Marriott.

Length ♂ 4.0 mm., wing 3.5 mm., ♀ 4.0 to 5.0 mm., wing, 3.5 mm. to 4.0 mm. *Head*: proportions of length, height and width, 3, 4, and 5; occiput slightly concave above, moderate below, bristles yellowish; frons as long as wide and slightly less than width of head, a little coarse, pale pubescence on middle, on black ocellar dot and on sides; bristles brownish, two inferior and two superior orbitals (the upper s.or. yellowish), ocellars moderate; lunule small; antennæ about three-fifths face, third joint distinctly angular at outer, upper end, arista very minutely pubescent; face flatly convex, oral opening large, cheeks about three-fourths width of third antennal joint, genæ one-fourth height of eye, genal bristle moderate. *Thorax* normal, rather sparse, coarse, whitish pubescence on dorsum, longer on pleura; bristles brown, normal, dorso-centrals on line of anterior supra-alars, a lower mesopleural and the pteropleural pale. Scutellum flat, straight-sided, four bristles; post-scutellum dull blackish; halteres and legs yellow. *Wing*: costal bristles small, third vein setulose to middle of first posterior cell, anal cell pointed; reticulation defined in marginal and submarginal cells. In the male the subapical bar is almost completely interrupted by reticulation, but is not obscured altogether as the hyaline spots are rather larger than elsewhere; there is a tendency in some specimens, rarely in others, towards a complete narrow hyaline bar, only interrupted by reticu-

lation in the second posterior cell. In the female the subapical bar is strong, the hyaline spots large and that in the marginal cell distinctly nearer the middle of the cell than in *conferta*; it is however always interrupted by a complete, or at most very slightly broken, reticulation in the second posterior cell. *Abdomen* normal, blackish at end in female; pubescence black, moderately shining yellow; sixth tergite in female about one-fifth shorter than fifth; base of ovipositor shining black, with black pubescence, about 0.9 mm in length, a little longer than fifth and sixth segments together; male genitalia yellow. *Puparium*. Length 4.0 mm Opaque, pale yellow to yellow, the anterior end darkened, or occasionally dark and the front end blackish. In lateral view the long axis is straight.

Biology. The material described here was reared by Mr. W. E. Marriott and he has made the following notes: — „Puparia were found in galls on *Senecio erubescens*, a very wide-spread plant. The galls occurred most commonly on the petioles of low fleshy leaves almost on the ground, but on the St. Lucia plant the variety *crepidifolius* of *Senecio erubescens*) one or two were found on leaves higher on the plants these being more robust and succulent than those at Moseley. The ordinary *S. erubescens* was also growing at St. Lucia, but had fewer and smaller leaves than even those at Moseley and had no galls on them. From specimens seen in the Natal Herbarium, Durban, the plant varies considerably.”

***Parafreutreta hirta* n. sp.**

conferta (Bez.), Munro, 1929, Bull. Ent. Res., XX, 397 — in part (*Parafreutreta*).

A moderately large, brown species of which the short antennæ and pubescent frons are characteristic.

Holotype ♂, allotype ♀, Durban, May 1936, W. E. Marriott; paratypes: 3♂♂, 7♀♀, Durban, May 1936, 8♂♂, 21♀♀, January-February 1933, W. E. Marriott; 1♂, 4♀♀, Durban, September 1926, E. W. Rust; 1♀, Durban, May 1930, 8♂♂, 2♀♀, October 1934, 1♂♀, 3♀, Umkomaas, Natal, October 1934, H. K. Munro; 1♂, Umbilo, Durban, C. C. Kent.

Length ♂, 4.5 to 5.5 mm., wing 4.0 to 5.0 mm., ♀, 5.5 to 6.0 mm., wing 4.75 mm. *Head* rather short, proportions of length, height and width, 7 : 11 : 13, yellow, occiput rather concave above, moderate, below, bristles yellow; frons half width of head and as wide as long, flat, entirely covered with moderate, coarse, yellow pubescence; bristles black except upper superior orbital and inner vertical yellow, ocellars moderate, two to three lower orbitals. It is curious to note that in a series of ten males and ten females, only one male has three inferior orbitals on each side, two have three on one side, the others two on each side only, of the females six have three on each side, while four have two. Lunule moderate. Antennæ half length of face,

third joint rounded at end, but upper edge fairly straight, arista bare; face concave below antennæ but the lower part somewhat protruding, cheeks about as wide as third antennal joint, genæ a quarter the height of the eye, the bristle weak; oral opening large and rounded.

Thorax reddish brown, pale coarse pubescence on dorsum, longer anteriorly and on pleura. Scutellum flat. Bristles normal, brownish, dorso-centrals a little before line of anterior supra-alars, four scutellars, one mesopleural and a pale pteropleural. Legs yellow, rather short. Halteres yellow. Wing yellowish with scattered, broken, blackish reticulation, the apical bar and that over the lower cross-vein wellmarked, but the costal, towards base, less pronounced; costal bristle small, third vein setulose to middle of first posterior cell, upper cross-vein a little more than its own length from lower, anal cell pointed. *Abdomen* yellowish, with blackish, strongly yellow shining pubescence of moderate length, bristles moderate on hind edges of fourth and fifth segments; male genitalia yellow; in the female the sixth tergite about half length of fifth: base of ovipositor short, 0.75 mm., shining blackish, more or less red, with black pubescence.

Puparium. Length 5.0 mm. Sub-translucent yellow; the long axis curved upwards in a lateral view about as in *conferta*, but the anterior end is narrower, that is, the diameter at the junction of the operculum is about three-fourths that at an equal distance from the hind end — in *conferta* these diameters are equal.

Biology. Practically all the material recorded here was reared; larvæ and puparia may be found in stem galls on *Senecio angulatus* at Durban throughout the summer if not nearly all the year round. The host-plant is the same as that of *Parafreutreta conferta*, and the biology similar to what has been described for that species (Munro 1926, p. 30). The galls occur on almost any part of the long-stemmed, rambling host-plant; probably, however, the eggs are laid nearer the ends of younger shoots which grow to a greater or less extent beyond the gall. The galls are much larger than those of *conferta*, from 1.5 to 2.5 cm. in diameter, and 2 to 4 cm. in length, varying also much in shape. Inside is a cavity in which the puparia, from six to a dozen, lie loosely, the larvæ having first made ready an exit for the adult flies.

***Parafreutreta hirta* Mro. var. *felina* var. nov.**

Holotype a female, Katberg, Eastern Cape Province, 11—18, II, 1937, R. E. Turner. Type in British Museum.

In the absence of more material it seems best to consider this (fig. 1) a variety of *hirta*, rather than of *conferta*, although it may represent a distinct species. In size and wing pattern it is like *hirta*, but the antennæ are longer even than in *conferta*. The head is crushed,



Fig. 1. *Paratreuteta hirta* M10, var. *jehna* Mro.



Fig. 2. *Paratreuteta pondocensis* M10



Fig. 3. *Paratreuteta actisparsa* Mro.

but the shape is probably as in the allied species; there are three inferior orbital bristles, but only a little pubescence in the middle of the frons; the antennæ are longer, about three-fourths length of face, in *conferta* two-thirds and in *hirta* a half.

The wing pattern is less reticulate and rather approaches what is found in the following new species; the membrane is however more strongly yellow and less hyaline with a stronger indication of reticulation in the discal cell; the third vein is setulose to a little beyond the upper cross-vein, which is its own length from the lower; it is also at about an angle of 60° to the veins above and below, these being more or less parallel beyond it. The base of the ovipositor is crushed but seems to be the same as in *hirta*.

***Parafreutreta pondoensis* n. sp.**

Holotype a female, Port St. John, Pondoland, August 15—31, 1933, R. E. Turner. Type in British Museum.

The specimen (fig. 2) is very similar in appearance and in coloration, but is larger (length 6.5 mm., wing, 5.5 mm.) than *hirta*. The head is crushed but probably of normal shape; antennæ two-thirds length of face; there are three inferior orbital bristles on one side, four on the other; the frontal pubescence is confined to the middle stripe and not all over as in *hirta*; occipital bristles yellow.

Thorax: bristles as in *hirta*, the dorso-centrals on line of anterior supra-alars, the pteropleural blacker; four scutellars. The wing-pattern is more open, the membrane yellow hyaline only becoming clearer hyaline in spots as in the middle of the discal cell, slightly in the third posterior, more strongly in the middle of cells in the paler, subapical bar (this appears more hyaline in the photograph than it actually is). The dark bars are formed of a broken, blackish-brown reticulation; in the marginal cell and base of discal there is no reticulation. The upper cross-vein is two-thirds its length from the lower and almost perpendicular to the veins, the fourth being curved somewhat downwards so that the first posterior cell is a bit widened; third vein sparsely setulose to upper cross-vein. *Abdomen*: base of ovipositor as in *hirta*, short conical, shining black; sixth tergite about half length of fifth.

***Parafreutreta pretoriæ* Mro.**

Munro, 1929, Bull. Ent. Res., XX, 397, Pl. XV, fig. 5.

Only the male type from Pretoria is known.

***Parafreutreta retisparsa* n. sp.**

A yellow species (fig. 3) very like *pretoriæ* of which it may be considered a variety; it differs in the pale wing-pattern and frontal pubescence.

Holotype a male, Port St. Johns, Pondoland, August 15—31, 1933, R. E. Turner. Type in British Museum. The specimen is rather crushed and damaged by the pin.

Length 5.0 mm., wing 4.5 mm. *Head* crushed, apparently of normal shape, yellow, frons about as long as wide, pubescence whitish-yellow, rather long on sides and on middle line, and on the ocellar dot some longer, almost bristle-like pubescence or coarse hairs almost as large as the yellow upper superior orbital bristle (in *pretoriæ* the pubescence is shorter and more scattered, with only a trace on the ocellar dot); bristles: three inferior orbitals lower superior orbital, moderate ocellars and inner verticals brown, otherwise whitish. Antennæ about two-thirds length of face, third joint with a distinct upper corner at end (not apparent in *pretoriæ*); arista microscopically pubescent (as far as may be ascertained there is none on the flagellum in *pretoriæ*), the basal joints conspicuous and with a marked constriction as in *pretoriæ*; face with white dust, width of cheeks not apparent owing to crushing, genæ about one fourth height of eye; proboscis short.

Thorax brown, slightly blackish with brown dust, pubescence coarse, yellowish-white; bristles brownish, dorso-centrals a little before line of anterior supra-alars, a strong, whitish bristle-hair below the mesopleural, pteropleural whitish, sternopleural brown, four scutellars; scutellum flat; halteres and legs (mostly broken) yellow; wing: third vein with fine, scattered setulæ to middle of first posterior cell; pattern a pale, almost uniform, close reticulation, slightly darker above the fourth vein and over the lower cross-vein, while on the posterior half of the wing the hyaline spots are larger; the pattern is very like that of *pretoriæ* in which, however, it is quite brown above the fourth vein and broadly so over the lower crossvein, the hyaline spots yellowish. *Abdomen* with brownish, shining pubescence, yellow on sides; genitalia yellow.

On the structure of lepidopterous larvae, with special reference to the mature larva of *Leto venus* Stoll

by

A. J. T. JANSE

INTRODUCTION

The object of this paper is twofold. Firstly it is intended to assist and encourage the study of larvæ, a subject of investigation of the greatest theoretical and practical importance, but hitherto scarcely touched on in South Africa. Secondly it is to record the structure of an interesting larva which, being a member of a very primitive family, the Hepialidæ, comes near in structure to the hypothetical larva, and may thus serve as a basis for the study of larvæ of specialized families.

As stated elsewhere, we do have a few records of life histories of Lepidoptera (some of which are the result of patient observation, giving descriptions and often illustrations of the various stages or *instars*), but no attempt has yet been made to study larval structure in such detail, and throughout the different instars, as to make it possible to show in a systematic manner resemblances and differences between larvæ of different groups. A photograph or coloured drawing may serve to help us to recognize with more or less certainty, the larva of a particular species, but it rarely if ever helps to throw light on the relationships of different species. It is like studying the wing markings and coloration of butterflies or moths, without reference to structural characters, which are often hidden to casual observation, such as wing venation, palpi, and genitalia. It may be said that such a superficial study of larvæ is hardly scientific, and the earnest student of life-histories should aim at deeper knowledge, if vull valvue is to be obtained from the labour and patience involved.

Two hypotheses should be kept in view. Firstly it should be remembered that Haeckel's recapitulation law can well be applied to the study of larvæ; this means (1) that the newly hatched larva shows primitive or ancestral characters which are often lost or modified in successive instars, and (2) that the more primitive the group is to which the larva belongs, the more its structure will resemble that of the ancestors, and the less modification there will be in the mature larva. Secondly the three Meyrick laws, so aptly applied by their author to the adult Lepidoptera, and used by him to arrive at a tolerably natural classification of the larger groups, apply not less to larval structure, throw important light on the classification of the adult. Here too, as Meyrick formulated, I. *no new organ can be pro-*

duced except as a modification of same previously existing structure; II. a lost organ can not be regained; III. a rudimentary organ is rarely redeveloped.

Apart from the purely scientific interest, larval study is not less important from the point of view of the economic entomologist. Damage to crops is done by the larvæ, not by the mature Lepidopteron, so it is of the greatest importance that the pest be recognized with certainty in the larval stage, so as to know the enemy, and how to combat it. Even in the case of some of the most common pests there has been confusion, with unfortunate results. The more scientifically the larvæ are known, the more scientific the control measures can be. Just knowing the food plant and the duration of the different stages is not enough, though this too should not be neglected.

Method recommended.

Begin with the newly hatched larva, if obtainable, and compare its structure with that of the larvæ of all the different instars.

Place the larva in alcohol of about 70 %; this kills it fairly quickly without shrinking or hardening the body too much. Hairy caterpillars are best killed in the cyanide bottle as used for mature insects.

Carefully cut open the body on the underside, midway between the legs; remove the digestive tract by cutting it transversely near the anus and head, and remove any loose tissue. Place the skin with its adhesions in a tube containing 10 % of caustic potash and leave it for 24 hours when the caterpillar is not longer than about 1 inch, or for a longer time when larger. Newly hatched caterpillars may be placed in the potash immediately after removal from the alcohol without having been previously cut open. Cleaning out is done in a glass dish under water by means of a small paint brush, until water and skin are quite clean. All glandular and muscular tissue is thus completely removed and the skin becomes somewhat transparent. Place it now in a concentrated solution of citric acid dissolved in water, so as to neutralize any of the caustic potash that may still be in the tissue. (I always place a few drops of magenta, dissolved in 50% alcohol, in the citric acid, so as to indicate perfect removal of the potash; as long as the citric acid solution is pinkish, the potash has been sufficiently neutralized). I find staining the skins for a day or so in 50 % alcoholic magenta solution of a medium cherry colour of advantage, as it differentiates the more or less chitinized parts of the skin.

After staining, the skin is spread out in a dish of 70 % alcohol, and kept in that position by means of a small piece of object glass on top of the skin. After an hour or so the 70 % alcohol is drawn away with a pipette and replaced by 90 % alcohol, and after another hour this is in turn replaced by absolute alcohol. After about one hour the

alcohol can be replaced by xylol, still leaving the glass slip on; after 30 minutes or so the skin will be transparent and also sufficiently hardened to remove the glass slip and place the skin in canada balsam on a slide to be covered with a cover glass in the ordinary way.

If the head is sufficiently large, I prefer to mount it with a little gum on a narrow pointed strip of bristol board or celluloid, when it can be placed in the cabinet next to the adult, by means of a pin, after it has been properly labelled. While the head is still soft the mandibles should be arranged in such a manner that the structure can easily be made out without removing the upper lip.

Very large skins have to be divided between the segments and mounted on more than one slide, but care should be taken to note which edge is towards the head, and the proper order of segments should also be maintained. The slides should be marked at once with the information as to species, number, etc.; this can be neatly done with india ink on a portion of the glass which has previously been covered with a very thin solution of canada balsam in xylol; the balsam must be allowed to dry before writing on it.

Observation and description should always be accompanied by a diagrammatic sketch, or as it is generally called, a setæ-map. This map can be simple in structure, but it is best to use a camera lucida so as to make sure that the setæ are drawn in their correct relative positions; this is an important factor in determining the names of the setæ present, and those that are absent, for each segment has the setæ arranged according to an original ground plan, more or less modified according to whether the larva is more or less specialized.

GENERAL DESCRIPTION.

The caterpillar body is made up of the head and thirteen body segments the latter indicated in the diagram by Roman figures. The first three segments, or thoracic segments, are each provided with one pair of true legs; the remaining segments represent the abdomen. The first two abdominal segments have no legs; segments VI—IX may each have a pair of prolegs, but sometimes these segments do not all bear prolegs; then follow segments X.—XII. which are without legs, and the last segment has a pair of rather broad clasping legs. Only segments I. and IV.—X. have *spiracles* or breathing pores, but rudiments of these may be present on other segments.

The *head* consists of two large subglobular portions, the *epicrania*, on which the antennæ and *ommatidia* can be found. The latter are usually referred to as the *ocelli* though structurally they are not ocelli at all, but rudimentary compound eyes. They are at most 6 in number and arranged in a definite manner. To designate the setæ each is given a letter and a number, the letter indicating

the portion of the head on which they are found, the figure naming the seta of that area. The space above the mouth between the epicrania is filled up by the somewhat triangular *frontal*, with the narrow *adfrontals* along the two sides; below the frontal is the *clypeus*, which has the upper lip or *labrum* attached. The labrum more or less covers the *mandibles* or jaws; below the mandibles is a flap composed of the lower lip, or *labium*, and the two *maxillæ*, the latter being more conspicuous than the former, and mostly modified. Between and above the maxillæ may be seen a segmented tube, the *spinneret*; the maxillary palpi are usually insignificant.

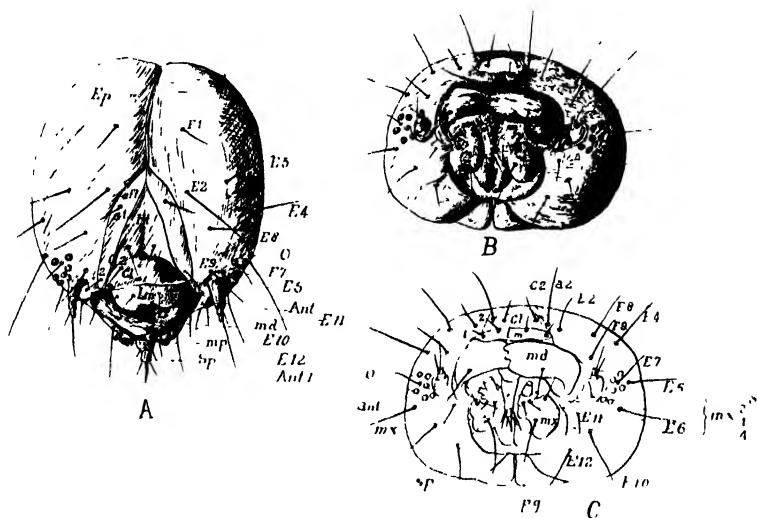


Fig. 1. Diagram of head of the caterpillar of *Leto venus*, $\times 5$. A. front view; B. underside; C. like B but the shading is left out to show the position of the setæ more clearly.

The underside of the epicrania is closed by two small triangular sclerites called the *postgenæ*. The *antennæ* at the side of the mandibles are short and three jointed.

Each epicranium may have 12 primary setæ, numbered here E 1—12, beginning with 1 on the top and then down and backwards, so that E 5 is just above the row of ommatidia, E 7 between the ommatidia, E 9 above the antenna, and E 10 and E 12 on the basal portion of the epicranium. The two setæ of the adfrontals are a 1 and a 2, a 1 being the topmost; the pair of frontal setæ require no numbers as I know of no instance where there are more; they are designated with the letter f and the position should be indicated relative to the base of the triangle. The clypeus can have 2 pairs of

setæ, the outer one being C 1. The labrum may have two pairs of central setæ, designated as l 1 and l 2, but there may also be three more pairs nearer the margin and then marked as l 3—5. Mandibles, antennæ, maxillæ, labrum and spinneret may or may not have setæ, but then these are always lettered and numbered according to the organ in question such as: md., ant., max., labr., sp. Secondary setæ are indicated with small letters behind the number.

This method of naming the setæ is practically the same as used by Heinrich, though this worker used Roman figures and left out the letter indicating the place where the seta is found. Forbes on the other hand used letters in addition to the numbers to designate the area of the epicranium, a procedure that has in my opinion little advantage. It should be borne in mind, however, that the numbering should be so as to leave numbers out for the corresponding missing setæ. When drawing a setæ-map of the body it is customary and simplest to draw the left half of each segment only and to represent this by an oblong, showing half of the dorsal and ventral part with the full lateral portion in between. The stigmata are represented by a double lined oval; the thoracic legs by a rather large oval, and the abdominal legs by an oval showing the hooks. Heavily chitinized portions with their setæ and also protuberances, etc. can be shaded in as shown in fig. 3.

The hypothetical segment has twelve primary setæ, and three sub-primary ones, the latter may be dotted in the figure. The sub-primary setæ are never found in the first instar, but may appear after the first moult; the primary setæ are all present in the newly hatched larva *when of a primitive type*. Additional setæ may be found in the specialized larvæ, and are called secondary setæ. These have a number according to the position of the corresponding primary seta and may be designated with additional small letters.

GENERAL PLAN OF SEGMENTAL SETAE.

Above the spiracle are two sets of three setæ, arranged in anterior and posterior rows; the spiracles themselves are placed posteriorly to the centre in the thorax, more anteriorly to the centre in the abdominal segments. Somewhat below the spiracle, and posteriorly situated, may be two setæ; before the spiracle and rather higher up may be a sub-primary seta. Above the leg are three setæ, and below the leg posteriorly is another, usually shorter one. Before the leg, rather low down, may be a sub-primary seta and somewhat midway between the leg and the spiracle may be another somewhat short seta, posteriorly.

In order to designate these setæ in the description and conveniently refer to them it is customary to give each seta a number

or letter which is kept constant for each seta even when some setæ are absent. Different authors have used different designations: Dyar, Quail and Forbes using Roman figures, Fracker using Greek

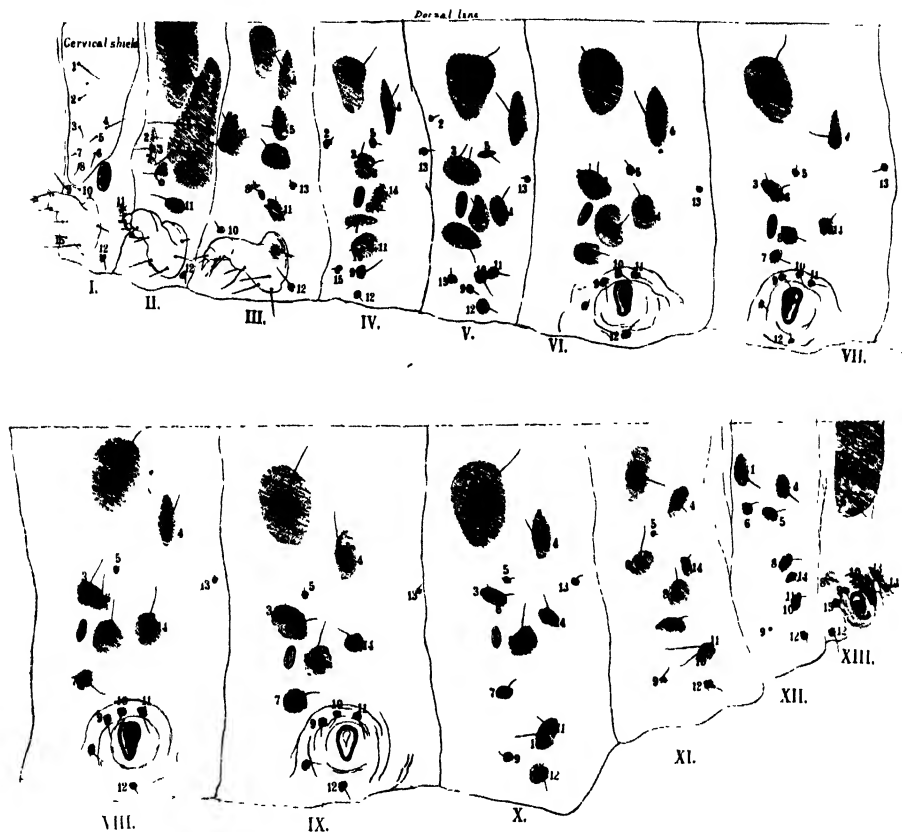


Fig. 2. Diagrammatic drawing of the caterpillar-skin of *Leto venus* as seen on the slides under a magnification of $2\frac{1}{2}$ times (only the left half of the skin is here represented). The shaded portions represent the more heavily chitinized areas, the darker the shading the more heavier the chitinization; when a dotted line is around the shading it indicates that there is a strong contrast between the skin and the chitinized portion; where the dotted line is omitted the change is gradual. A. gives segments I. to VII.; B. segments VIII. to XIII.

letters. Each of these appear to me somewhat cumbersome; the Fracker system may at first even be somewhat bewildering to the nonclassical student, though with a little practice one soon gets used to it. I prefer ordinary figures, *provided that one leaves a corres-*

ponding figure out when its seta is missing. For students who want to use literature by these authors the following table makes the relation quite clear.

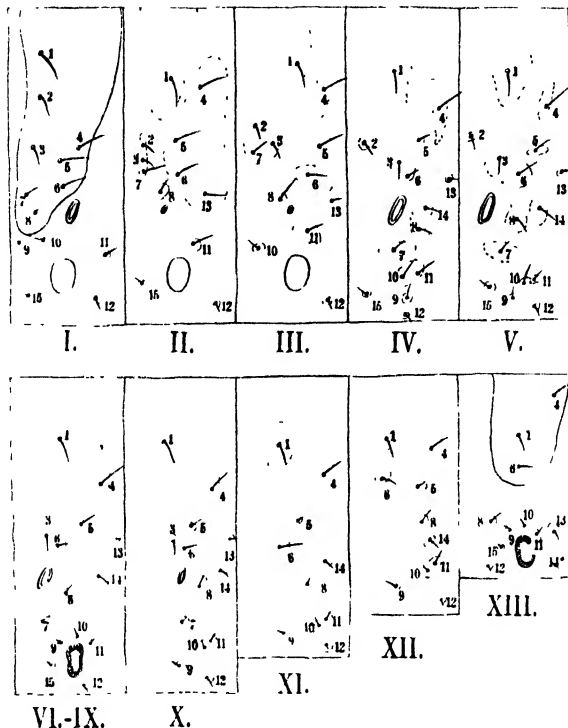


Fig. 3. Setae-map of caterpillar of *Leto venus* based on figure 2; segments VII, VIII., IX. are omitted, as they are identical with VI. The chitinized areas are shown with dotted lines only

Thoracic Segments

	Figures used in this paper	Dyar 1901	Quail 1904	Forbes 1910	Fracker 1915
primary setae	1	1	1	1a	α
	2	—*)	—	x	γ
	3	iii	iii a	ii a	ϵ
	4	ii	ii	ib	β

*) Where a stroke is used the author did not mention the seta, or it was absent.

	Figures used in this paper	Dyar 1901	Quail 1904	Forbes 1910	Fracker 1915
primary setae	5	—	—	—	δ
	6	iv	iii	iib	ρ
	7	vb	vi	v	η
	8	v	v	iv	κ
	9	—	—	ix	τ
sub-primary setae	10	—	—	—	ν
	11	vi	vii	vii	π
	12	—	—	viii	σ
	13	va	iv	iii	θ
	14	—	—	—	μ
	15	—	—	—	ω

Abdominal Segments

	Figures used in this paper	Dyar 1901 Frenatae	Quail 1904 Frenatae	Forbes 1910 Frenatae	Forbes 1910 Jugatae	Fracker 1915
primary setae	1	i	i	i	i	α
	2	—	—	x	—	γ
	3	—	iiia	iiia	iiia	ε
	4	ii	ii	ii	ii	β
	5	—	—	—	—	δ
	6	iii	iii	iii	iii	ρ
	7	v	v	v	vi	η
	8	iv	iv	iv	v	κ
	9	vi	vii	vii	vii	τ
	10	vi	vii	vii	vii	ν
	11	vi	vii	vii	vii	π
sub-primary setae	12	—	—	viii	viii	σ
	13	—	—	—	iv	θ
	14	vb	vi	vi	—	μ
	15	—	—	ix	ix	ω

It will be seen that the figures given by me are in the following order: 1—12 primary; 13—15 sub-primary; 1—6 those above the spiracle (1—3 for the anterior row, 4—6 for the posterior row); 7, 8 for the subspiracular setae; 9—11 for those above the leg or, where the leg is absent, in that place; 12 for the seta below the leg and posteriorly placed; of the sub-primary setae 13 is for the one near but posteriorly to the thoracic spiracle, well above and posteriorly to the abdominal spiracle; 14 for the seta above setae 9—11; 15 for the seta most ventrally and anterior to the leg.

In diagrams it should further be noted that the heavily chiti-

nized area or *pinaculum* may be shaded in or, simpler still, the area may be indicated by a thin line especially when more than one seta is placed on that area. On the first and last segment the dorsal portion is usually heavily chitinized and designated as the *cervical* and *anal plate* respectively.

DESCRIPTION OF LARVA OF LETO VENUS STOLL.

Head.

Epicranium somewhat oblong, rather smooth; setæ 1—12 present; 7, 11 moderately long, the others quite long; ommatidia all present, four with the E 7 seta in the centre, the two others more posteriorly; adfrontals long, narrow, a 1 seta at about two-thirds, a 2 near lower end; clypeus with c 2 only, c 1 missing; labrum with 4 setæ in a row and just above middle, marginal setæ absent; antenna three jointed and with 2 setæ, a short one from end of second joint, a very long one from tip of third; mandible with one seta on lower side and from before middle; maxilla three jointed; first joint very broad; 2 setæ of medium length from second joint, 2 from basal joint, one of which is very long; spinneret three jointed, base of first and second joint each with two lateral setæ.

Thorax and Abdomen.

Segment I. Neckshield large, extending to just beyond the spiracle and with setæ 1—8; 1 a little nearer to 2 than 3 is; 4 a little higher than 3; 4—6 and 7, 8 evenly spaced; 7 and 8 in a row with 1—3, but at lowest tip of neckshield; spiracle well developed, large; 13 and 10 well before and below tip of neckshield; 11 well below spiracle and near posterior edge of segment; 12 in a line with 11 and lower part of leg; 9 well before leg and a little higher than 12; a small area of skin around 11 and 12 moderately chitinized, such an area is called the *pinaculum*.

Segment II. Across the anterior dorsal area is a broad, well chitinized, bulging shield, provided with seta 1, and with a small protuberance above it posteriorly; lower down and posteriorly is a similar bulging chitinized plate, well remote from the dorsal line; this has setæ 4—6 and 13, the pinaculum of 13, though merging into the larger area above, shows a clear demarcation line which is less chitinized; setæ 2, 3 and 7 in a row on a narrow elongated pinaculum; seta 8 on a slightly chitinized pinaculum and well above the rudimentary spiracle *); 9 and 10 absent; above the leg and somewhat posteriorly is seta 11; 12 and 15 as in II.

*) According to Fracker and other workers the spiracle is entirely absent on segments II and III. in the larva of *Hepialis mustelinus* and *H. humuli* but, though small and probably not functional, it is clearly present in the larva of *Leto venus*.

Segment III. The shield on which 1 is placed is much smaller than in II, and more central; 2, 3 and 7 triangularly placed on one subtriangular pinaculum; 4, 5, and 6 on moderately separate pinacula, 4 and 5 in a row, 6 a little more to the centre; 8 as in II.; 10 as in I; 11 and 12 as in II.; 15 absent, (possibly present but in the only specimen I have I cannot find it on either side of the caterpillar); spiracle as in II.

Segment IV. Seta I as in III.; 2 on a small isolated pinaculum remote from the pinaculum of 3,6; 3 and 6 on a broad oval pinaculum, centrally placed well above the spiracle; 4 as in III., but a little lower; 5 more centrally placed than in III. and on a much smaller pinaculum; 8 and 14 on a suboval pinaculum, situated well before the spiracle, (in all the following segments possessing a spiracle 8 retains this position though becoming isolated from 14); 7 well below the spiracle and a little before middle of segment **); 10 and 11 on a large oval pinaculum, placed below and beyond 7; (this position is retained in segments V., X.—XII); 9 below pinaculum of 10,11; 12 *immediately* below 9; 13 as in III. but a little higher up; 15 as in II.

Segment V 1—6 as in IV., but the pinaculum of 3, 6 is larger and 5 is placed more posteriorly; 8 and 14 are on separate pinacula and 14 is placed more posteriorly; 7, 13 and 15 as in IV.; 9, 10 and 11 each on a separate small pinaculum arranged in a curved row, as found in all segments VI.—X.; 12 as in IV. but more posteriorly.

Segments VI.—IX. 1 on a large oval pinaculum; 2 absent; 3 and 6 on an oval pinaculum, placed as in IV.; 4 and 5 as in V.; 7, 8, 14 and 13 as in V.; 9, 10, 11 each on a separate small pinaculum and arranged in a curve above the leg; 15 below 9 on anterior side of leg; 12 below the leg and a little posteriorly; pinacula of 12 and 15 small, rounded; leg with a single row of hooks (*crochets*). I can see no difference in the position of any setæ on these segments and the arrangement comes very close to that of segment V.

Segment X. 1—6 as in VI; spiracle somewhat smaller; 7, 8, 13 and 14 in the same position as in VI. but the pinacula are smaller; 9, 10, 11 as in V. but 10 and 11 on one pinaculum; 12 as in VI.; 2, 13 and 15 absent.

Segment XI. 1, 4, 5, and 6 as in X; spiracle absent; 8 and 14 as in X.; 9—12 as in X.; 2, 3, 7, 13 and 15 absent.

Segment XII, 1 and 4 as in XI. but 4 more dorsally placed; 6

**) The lowering of 7 till it is well below the spiracle may seem too great a distance as compared with 7 in I.—III., but it should be borne in mind that the abdominal spiracles are placed much more anteriorly than the thoracic one. Compared with the other abdominal segment there is no other logical designation, unless we accept the disappearance of 7 and the appearing of a new secondary seta; of course, only the study of a newly hatched larva can give certainty.

much nearer to 1 than in XI.; 8 between 5 and 14; 14 remaining as in XI.; 9, 10, 11 and 12 as in XI.; 2, 3, 7, 13 and 15 absent.

Segment XIII. Anal shield with 1, 4 and 6, 1 below midway of 4, 6 and more anteriorly to 6; 4 rather nearer to dorsal line than in the other segments; 8 anterior to 15; 9, 10, 11 above leg and placed in a curve; 10 and 11 on one elongate pinaculum; 13 and 14 on one large oval pinaculum posterior to the leg; 15 before middle of leg; 12 well below 15 and more anteriorly; leg with an incomplete circle of crochets arranged in a single row.

From the above description it will be seen that most segments have retained their primary and subprimary setæ; that few secondary setæ are formed; that primary setæ which are present in the thoracic segments have a tendency to disappear in the abdominal segments, more so when these segments are caudad.

As to the life history of this interesting insect very little is known. Dr. H. Brauns told me that the larva lives under the bark of a certain tree and he suspected that it would take freely to the Wattle tree now planted near its habitat in the Knysna, the only place from which the moth is known. However, he never found the larva himself. In fact what is known about the life history by one local family is kept secret, with a view to restricting the market of this beautiful moth and thus keeping up the price. As far as I know all specimens known have been bred by this family, none having been captured flying about.

The solitary larva, together with a pupa, were kindly presented to me in 1922 by Miss E. G. Newdigate of George. I herewith wish to express my sincere thanks to her for this interesting material.

In conclusion I express the hope that this article may show the South African student how interesting the study of caterpillars can be, and how to set about it with advantage to science.

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On collecting, preserving and packing lepidopterous insects

by

A. J. T. JANSE

HANDLE LEPIDOPTERA WITH LOVING CARE.

Very frequently some of my kind correspondents send me batches of Lepidoptera either for identification, or for incorporation in my collection, or both. Unfortunately it often happens that consignments arrive in such a bad state of preservation, that the specimens are of very little scientific value, and their identification is practically impossible. Such material testifies to the great zeal of the collector, but it also shows that he has not observed certain simple rules which should be followed in collecting and packing Lepidoptera. This article has been written with the object of explaining how these insects should be collected and preserved in order to obtain good specimens.

Firstly it should be remembered that protecting possible tufts of scales on the thorax and the abdomen is as important as (often even more so than) preserving the wing markings, though the latter should also be obliterated as little as possible. The former are often required for generic identification. Secondly, palpi, antennæ and legs are as important as wing venation; the veins sometimes become too plainly visible at the expense of the wing markings, through the rubbing off of scales during collecting or packing.

Collecting: In the day time collecting is generally done with the well known butterfly net and it is here that some of the damage is already done by the rather objectionable method of killing — or half-killing — the insect by squeezing the thorax. The larger butterflies will hardly be damaged in this way, if it is carefully done, but the smaller ones and all the heterocera cannot escape damage when this method is adopted, as can be readily seen by the scales and sometimes legs left on the inside of the net.

The coarser the net the greater the damage, hence use a net of the thinnest possible material; I find silk the best and prefer what is known as chiffon. This tears easily, especially when wet, so keep it dry and it will last at least a whole season. Also keep the stick short — three feet is long enough for most purposes — or you will catch more thorny branches than Lepidoptera. A short stick in the free hand helps to chase up any Lepidoptera that may hide in the denser vegetation, and these are easily netted when the net in the other hand is quickly manipulated.

I prefer to take the insect out of the net by introducing the open killingbottle into the net and manoeuvring the insect into it by making the flying space within the net smaller and smaller; when the insect is in the bottle the net is folded back again over the mouth of the bottle, the stopper is placed loosely on top of this and held in place, while the double net-wall is withdrawn. When the cyanide in the bottle is as strong as it should be the insect will flutter for a very short time only and, *as there is nothing else in the bottle*, no damage is done.

When the insect does not move any more take it out and put the thinnest pin through the thorax, no. 00 (or, for smaller insects, „minutien”) pins will serve for all but the biggest, and will do no damage when the pinning is carefully done. If the wings are folded, the pin may even go through it side ways. Large butterflies may be placed in the well known triangular envelopes. However, the insect is probably not dead yet, so it should now be placed in a close-fitting box in which a lump of potassium cyanide is placed, enclosed in a small cloth bag which is fixed to the box with pins. For the pinned insects this box should have a corklined bottom; for the envelopes no cork bottom is required except for fixing the cyanide bag; another cyanide bottle will do for envelopes just as well.

Killing-bottles intended for Lepidoptera should not be used for the killing of beetles, for the latter often make the bottle wet with a fluid that will stain and spoil the butterflies or moths.

Collecting moths at night is best done by attracting the insects with a strong light, and consequently a different method of catching can be adopted. As for the light, never use acetyline light for it hardly attracts insects at all. Electric light, *shining on a white cloth*, is excellent, but in the bush a gas-lamp with a mantle will be found most useful. The stronger the light, the better it works. It will be found that the moths will often settle, if only for a moment, on the white cloth. Then cover the insect quickly over with an open box which has a glass bottom, or failing this a glass tumbler will do, as long as it is dry on the inside and fits the mouth of the killing-bottle. Insert a stiff card, such as a postcard, between table and the box or tumbler and remove the whole to the top of the opened killing-bottle. withdraw the card and the insect will fly or drop into the bottle without being touched.

Put only a few of the same sized Lepidoptera in the bottle at a time. When the insect does not move any more it may be dropped into another killing bottle, which I call the store-bottle. In this bottle even a hundred moths may be accumulated without risk of damage, provided they are sufficiently stupified in the first bottle. For killing and storing several bottles can be used with advantage, reserving one for large, medium and small moths respectively. All bottles should

be closed immediately after the insect is put in it, in order to prevent too much escape of cyanide gas. Leave the insects in the store-bottle over night; they are sure to be dead next morning if your bottle is well charged with cyanide, and yet they will not be too stiff then for setting, pinning or packing.

Preparing the catch: Firstly avoid picking up the specimens with your fingers, however delicate your touch may be; pick them up with forceps with a good deal of spring over the whole length so that the points press only slightly. The usual pinning forceps may do damage even to medium-sized Lepidoptera. I prefer a home-made pair of forceps made out of clock spring straightened out.

When it is possible to set the specimens while quite fresh, do so by all means for remember that relaxing never improves the specimen, while it sometimes ruins the colour; green nearly always discolours in relaxing. The smaller the specimen the more difficult it is to set it satisfactorily. If setting of these has to be postponed, pin them properly as for setting and place them in rows in a small box with peat at the bottom, covered with rather rough paper. The specimen has to rest with the abdomen on this paper and, by blowing against the wings from behind the wings will be roughly spread and held in position by the paper. As the long cilia and the hindwings are thus removed from the body they will not so easily get too damp and thus cling to the body in relaxing.

As for the pinning, this should be done most carefully. The pin should go through the mesothorax without removing crests or amputating one or more legs. Select the thinnest pin possible, compatible with safety. *Use steel pins*, made of *rustless steel* when obtainable; brass pins frequently corrode, and will always corrode when the larva has lived inside a plant stem (visible by the verdigris formed), ruining the specimen after a few years.

Species which are in the habit of folding the wings together are best packed in the well-known triangular envelopes; when they are large only one must be put in an envelope, when rather small more than one may be placed in it so as to save work, provided they come from the same locality; for locality and date are of course written on the envelope.

Never press the filled envelopes too tightly even when the specimens are still fresh, for this may squash the thorax and thus make a weak spot for pinning. It is a good habit to place some cotton wool at the bottom of the box first before placing the filled envelopes in it; also arrange them so that the thicker portions, containing the bodies, are fairly evenly distributed in the box. When the filling of the box is interrupted while new Lepidoptera still have to be caught, place a light weight on the envelopes, such as a small piece of wood, just heavy enough to keep them down *without too much pressure*;

put some naphthaline about the papers and leave the box open so that the specimens can dry sufficiently.

A method of packing, which I have found very satisfactory *provided it is properly done*, is placing the specimens between cotton wool. A rectangular tin will be best, and the cotton wool should be of the kind that is glazed on the one side; or failing this, thin tissue paper or paper wool should be used between the layers of cotton wool. Cut the cotton wool to the exact size of the inside of the box and use as many sheets as you think you need for filling the box without pressing too much on the cotton wool.

Place a little naphthaline on the bottom of the box and on to this a strip of paper nearly as broad as the box is wide and as long as the length of the box plus its double height, plus about 2". Fold the paper so that it fits neatly on the bottom and along the two narrow sides, then fold the projecting inch over the two edges. On this paper place a piece of thin cardboard nearly the size of the bottom of the box and on that one layer of cotton wool with the glazed side downwards. On the cotton wool the *still fresh* specimens are arranged in such a way that they do not overlap. It is astonishing how many specimens can thus be accommodated with little trouble and the packing goes a least 20 times quicker than papering them. Each layer should have a very small label with locality and date.

On top of the specimens place the next sheet of cotton wool *with the glazed side downwards* so that it can be lifted off the specimens without their adhering to the upper layer of cotton wool; or, if no glazed cotton wool is available, then first put a piece of tissue paper on the insects and on top of that the layer of cotton wool. On this the next layer of insects can again be arranged, and so on till the box is full.

If there are not sufficient insects at the time to fill the box, another strip of paper should be placed on the layer of cotton-wool covering the last layer of insects. On this paper the other sheets of cotton wool are placed to fill the box and some light weight should keep it in place, so that it *presses moderately and evenly* on the cotton wool without interfering with the drying of the insects. It is obvious, that by lifting this last strip of paper, one can lift the empty sheets of cotton wool out of the box without disturbing the insects, or breaking the insects by lifting the first strip of paper carefully. To do this lifting smoothly the walls should be smooth, such as those of a tin box. Also the box should be strong enough if it is to be sent through the post, if rather frail it has to be placed inside a stronger box. When the box is full it should not be closed entirely until about a week later, so that the specimens can dry sufficiently, especially when the atmosphere is rather damp. However, I have never found a mouldy specimen between the cotton-wool. Some naphthaline on top

of the last layer of cotton wool will keep insects away while the box is not quite closed.

A few words in conclusion. This country is changing rapidly. The larger animals are practically exterminated to make room for agricultural pursuits; but this is not less true for the indigenous flora, which becomes more and more restricted and with that the insect fauna is quickly changing. The time is not very distant when many species of insects of the greatest interest to Science will become extinct and thus lost for ever, *unless they are collected now* and adequately preserved in recognized institutions, where they may be available for students even in the far distant future.

As an example I will mention one striking case. In 1917 I discovered in the virgin bush of Karkloof (Natal) the first specimen of *Agrionympha pseliacma* Meyr., the first South African member of the most primitive Lepidopterous family, the Micropterygidæ. Though we have many species in South Africa of a closely allied but less generalized family, the *Hepialidæ*, yet it was thought that no Micropterygids existed in Africa south of the Sahara, at least none were ever found until 1917, and then one specimen only! Eager to secure more, I visited the same spot in 1930, only to find that my lovely glade, the type locality of this insect, was gone; in its place were now the more prosaic wattle trees! Deeper into the mountain I found some places that would likely contain the desired species, but after a week of search only one other specimen was secured.

Many more examples could be given of species caught once only, never to be seen again; but this will show sufficiently that more intensive and more systematic collecting and *preserving* must be done, if we are in the future to have a fairly comprehensive picture of our original insect fauna. If this article should help a little towards this aim, I would be well rewarded for the trouble of writing it.

Systematic and biological notes on some brachycerous Diptera of Southern Rhodesia

by

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The following paper consists of short systematic and biological notes on some Stratiomyidæ and Asilidæ of Southern Rhodesia. The immature stages of *Ptecticus posticus* Wied., *Neolophonotus porcellus* Speis., and *Promachus negligens* Ad. are described, and notes are given on the distribution and habits of some little-known Dasypogonine "robber flies". *Lasiocneme fascipennis* n.sp. from S. Rhodesia and N.W. Tanganyika, and *Stichopogon maculipennis* n.sp. from Urungwe, Lomagundi district, are described.

Family STRATIOMYIDÆ.

Sub-fam Geosarginae.

1. *Ptecticus posticus* Wiedemann.

Wiedemann 1830, p. 34; Loew 1860, p. 6.

In Africa very little information is available regarding the breeding places of Stratiomyidæ. In S. Rhodesia *Microchrysa deanulata* Lindr. has been reared at Salisbury from larvæ in cow-dung and litter, associated with the larvæ of *Stomoxys*. *Aspidacantha atra* Kerl., *Sternobrithes locwi* Lindr. and *S. tumidus* Lw. breed in decaying tubers of potatoes and sweet potatoes (*Ipomoea*) at Salisbury. *Ptecticus posticus* Wied. inhabits the kloof-forests of the Vumba Mountains (5,000—5,500 ft.) near Umtali, and breeds in the decaying fruits of a tree, *Conopharyngia johnstoni* Stapf. (Apocynaceæ). Species of *Odontomyia* which breed in water have not been investigated.

The larvæ of *Ptecticus* are slow-moving, living in the semi-liquid mass of decaying flesh of the *Conopharyngia* fruits. They were associated with the larvæ of crane-flies (Tipulidæ), *Rhyphus annulicornis* Edw. (Rhyphidæ) and other dipterous larvæ. When fully fed the larvæ entered the soil, and pupated within the last larval skin (puparia). The duration of the pupal stage in March, 1938, under outdoor insectary conditions at Salisbury, varied from two to three weeks. It was observed that the imago emerged through a T-shaped slit in the thoracic segments of the puparium, the head and prothoracic segment usually falling away during the process. The pupal

skin did not protrude from the puparium after eclosion, as was recorded for a related species, *Solva caffra* Big., (Xylophagidæ), by the authors, Engel and Cuthbertson (1937, pp. 3—4).

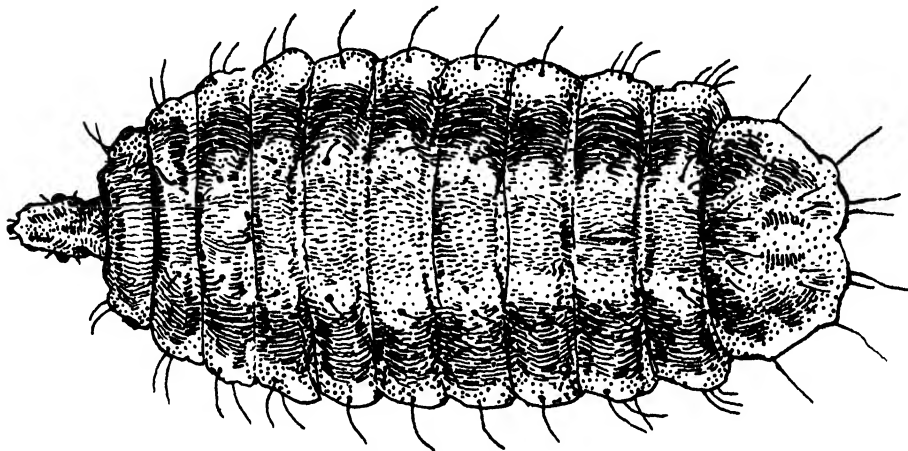


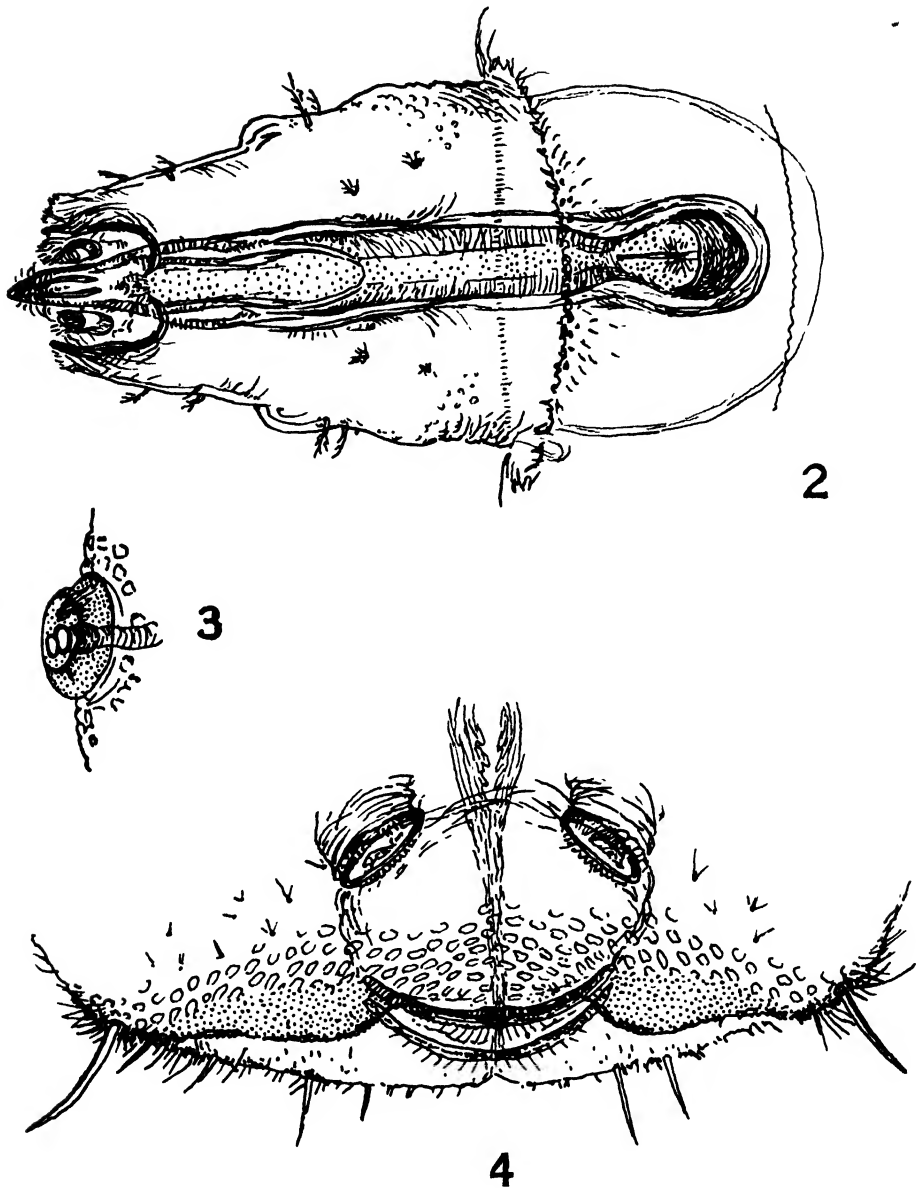
Fig. 1. *Ptecticus posticus*, larva: dorsal view.

Description of Larva.

Length of mature larva 10—12 mm., breadth 4 mm.; body flattened dorsoventrally, consisting of twelve apparent segments including the head; general coloration on dorsum yellowish brown with three dark broad longitudinal stripes or bands, the middle band being indistinct; underside of body of a light yellowish brown colour without markings; integument of head and body granulated amphipneustic, non-functional lateral spiracles not observed.

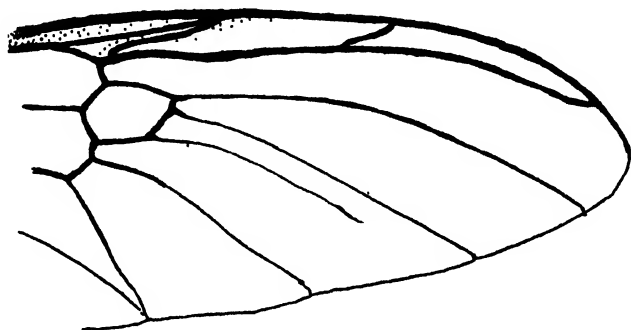
Head and mouth parts (Fig. 2), head long and narrow, not retractile; on the anterior part laterally with three pairs of plumose hairs, and behind the so-called "eye spots" one longer pair of plumose hairs; ventral side of head with two pairs of plumose hairs. Mouth parts with a beak-like labrum, and two long curved ventral sclerites; pharynx with an endoskeleton attached, and ending in a chitinized "bulb" situated in the first thoracic segment. Mouth opening divided by a partition, as shown by Becker (1910).

Thorax: thorax with a pair of simple bristles, long and outwardly directed on lateral margins of each segment; second and third segments with a bristle on each side of the middle band; first thoracic segment on the underside with nine bristles, second and third segments with six ventral bristles. Anterior spiracles (Fig. 3) situated laterally on prothoracic segment, with two round openings, and a thick peritreme.

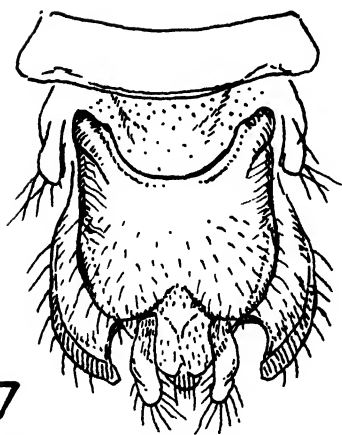


Figs. 2—4. *Ptecticus posticus*, larva, 2: cephalic segment, ventral view; 3: anterior spiracle, lateral view; 4: apex of terminal segment, showing posterior spiracles.

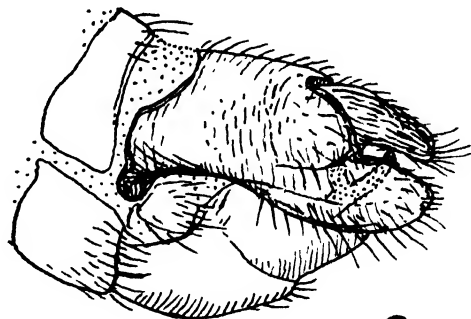
Abdomen: a bristle present on each side of the middle dorsal stripe, and strong lateral bristles on segments one to five; segments six and seven with three or four lateral bristles, terminal or anal segment with four pairs of marginal bristles, no bristles on under-side of anal segment; posterior spiracles (Fig. 4) are situated on the anal segment which resembles the mouth of a fish, and which opens by a ciliated transverse slit; each spiracular plate is provided with numerous marginal "openings".



5



7



6

Figs. 5—7. *Ptecticus posticus*, 5: wing; 6: male terminalia, lateral view; 7: male terminalia, dorsal view.

The specimens of *Ptecticus* reared from the larvæ described above, agree with specimens determined as *Ptecticus posticus* Wied.

in the Zoologische Staatssammlung, Munich. They differ, however, from the original description in their wholly dark-coloured hind tarsi; another species, *Ptecticus elongatus* F., which has the second, third and fourth joints of the posterior tarsi white, also occurs in the forests of the Vumba Mountains, and it has been observed at decaying fruits of *Conopharyngia*. We have, therefore, illustrated the venation of the wing, (Fig. 5) showing the vein R_{2+3} meeting R_1 near the margin, and the male genitalia (Figs. 6 & 7), in order to establish the identity of the species which we have studied.

Family ASILIDÆ, (Robber Flies).

Sub-fam. Leptogasterina.

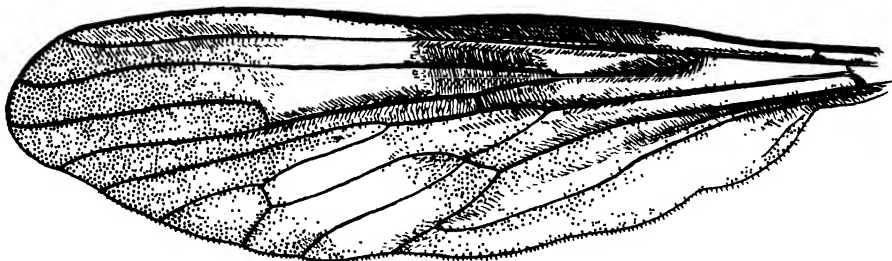
2. *Lasiocnemus fascipennis* sp.nov.

L. fascipennis was mentioned but not described by Prof. Hermann 1924, p. 149, and consequently we take this opportunity of briefly describing it.

A large species; length of body 20–26 mm., of wings 12.5–13 mm.

Head: face brassy yellow with shimmering patches in certain lights; mystax composed of black bristles, proboscis and palpi black, colour of antennæ mahogany brown to black; third segment one and a half times as long as the two basal segments together; terminal bristle short, greyish pubescent; vertex and occiput blackish with ashy grey dust and black hairs which are greyish on lower part.

Thorax: anterior part of thorax and the pleura more or less mahogany brown to dark reddish, somewhat shiny with a dark middle stripe; posterior part of thorax and upper part of pleura blackish with short whitish pubescence; metapleural hairs black; postalar bristles short.



Wings: (Fig. 8) with two broad brown transverse bands, the proximal one being almost black at the fore margin and becoming lighter towards the hind margin; the apical band extends from the tip of the wing to a line which cuts the apex of the discal cell, and the base of the fork of the third longitudinal vein; venation as in Fig. 8: five posterior cells, anal cell closed and with a long petiole, as in some other species of *Leptogasterinæ*.

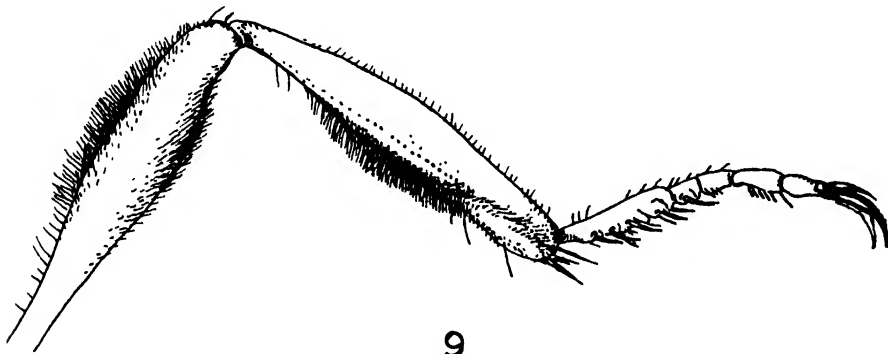


Fig. 9. *Lasiocnemus fascipennis*, hind leg.

Legs: reddish to mahogany brown, posterior femora and posterior tibiae spindle shaped, appearing dark owing to the covering of short black hairs; apical part of posterior tibiae and posterior metatarsus on underside with shining greyish white pubescence; the four apical spurs of posterior tibiae, the two spurs of anterior and middle tibiae, and the bristles on the underside of the tarsi are black. Empodium, or median bristle, is three quarters as long as the black claws.

Abdomen: dark mahogany brown; apical three abdominal segments of male and apical four segments of female, swollen, dark-coloured; anterior border of second tergite, and posterior border of other tergites with grey dust; first tergite short, with black bristly hairs; the sides of second tergite with some soft greyish hairs; sternites black on basal part, else-where brownish with some white pubescence. **Hypopygium:** blackish brown with yellow hairs, upper forceps furcate.

Holotype male, in copula with female, N.W. Tanganyika, (coll. Grauer). **Allotype**, female; both in Zoologische Staatssammlung, Munich. **Paratype** female, Lomagundi, March, 1938. (coll. R. H. R. Stevenson) in National Museum, Bulawayo.

Sub-fam. **Dasypogoninae.****3. Hyphenetes stigmatias** Loew.

Loew 1857, p. 350; 1860, p. 89; Engel 1929, p. 166—7 Fig. 14.

In Southern Rhodesia this species is known only from the Urungwe sub-district, Lomagundi. The flies occur on rocks in dry riverbeds, and on the ground. A female was taken with a small Hymenopteron on 22nd August, 1938, by J. G. Clarkson.

4. Gonioscelis mantis (Loew) Engel.

Engel 1925, p. 168—9.

A large species which is common on the western commonage of Salisbury during April and May. The flies occur on the ground or rest on tall grass stems beside sandy paths in shade. They prey upon small beetles.

5. Gonioscelis submaculatus Speiser.

Speiser 1910, p. 90.

In S. Rhodesia this species occurs in the Nyamandhlovu district in Matabeleland, and in Northern Lomagundi, Mashonaland. It is prevalent in the Urungwe sub-district, Lomagundi, and at Kariba Gorge on the Zambezi River during August and September. The flies occur on the ground and prey on small insects, such as Stratiomyid flies and Hymenoptera.

6. Scylaticus punctatus Engel.

Engel 1932. pp. 281-2.

A scarce species in Rhodesia, being known from the Bulawayo district and Nanganya River, Urungwe, Lomagundi district, one male being taken in October, 1938, by W. L. Williams. The basal segments of antennæ and the hypopygium are mostly reddish brown.

7. Stichopogon inaequalis Loew.

Séguy 1927, p. 62.

Widely distributed in Mashonaland, having been recorded from the Lomagundi, Salisbury, Marandellas and Hartley district. The species is prevalent from August to December. The flies occur on sandy soil usually near pools, rivers or ditches, and when disturbed fly only a few feet from the observer. The colour of the eyes of both sexes in life is dark brown, and not green, as is usual for Asilidæ and some other predaceous insects. The prey consists of small soft-bodied insects such as acalyptrate Diptera. A female was observed

repeatedly attempting to capture a small fly, *Lispa leucospila* Wied. at Wedza on 27th December, 1938.

8. *Stichopogon maculipennis* sp.nov.

A small species (6.5—7.5 mm.) allied to *S. punctum* Lw. and *S. hermanni* Bez., with reddish legs, and a diffuse brown patch near the apex of the wing. *Head*: mystax in male whitish, in female yellowish white, confined to the upper margin of the mouth opening, some scattered white hairs on the silvery white face. Frons golden ochreous covered with fine white hairs; vertex and ocellar tubercle with yellowish bristles.

Thorax: pleura and metanotum with silvery white tomentum; mesonotum with a complicated design of ochreous and silvery white spots and brownish stripes. Chætotaxy as follows: one intraalar, one supraalar and one or two postalar bristles, the latter mixed with some yellowish hairs. Posterior margin of mesopleura with some longer white hairs; metapleura with white hairs in the "fan" of bristles. Scutellum ochreous with yellow hairs on disc, and a double row of marginal bristles.

Legs: reddish, covered with fine white tomentum, metatarsus reddish, the other joints of the tarsi darker, brownish; bristles and short hairs on legs wholly white; claws black, pulvilli brownish. *Wings*: venation as in *O. punctum* Lw.; posterior cells open, anal cell closed and with a short petiole or stalk; colour faintly clouded, veins brown, yellowish at the base and on the fore border of wing; a diffuse brownish patch near apex of wing stretching from R_1 to R_4 (upper branch of fork). Halteres yellowish.

Abdomen: silvery grey with the hind margins yellow; tergites each with a brown triangular marking, the first tergite with a small round spot, second and third tergites with a large marking; the triangular marking on each tergite has its base on the yellowish posterior margin. In the female the markings are of equal size on the second to fifth tergites, the sixth and seventh being wholly brown. In the female, the last two tergites are whitish. The spines of the ovipositor are black, the lateral lamellæ are brownish, triangular, simple in structure, with a white ciliated margin. The ground colour of the last three tergites of male is somewhat ochraceous. The hypopygium of male is silvery white.

Holotype male, and *Allotype*, female, Kariba Gorge, Zambezi River, Urungwe, Lomagundi district, 9th July, 26th Aug. 1938, (*J. G. Clarkson*), to be deposited in the National Museum of S. Rhodesia, Bulawayo. *Paratypes* are in the Zoologische Staatssammlung, Munich, and in the collections of the Entomological Branch, Salisbury.

Note on habits and prey: The flies occur on sand near the water's edge, Zambezi River at Kariba Gorge. The prey observed by W. L.

Williams and J. G. Clarkson were small grasshoppers, and a homopterous bug, *Dictyophora* sp. The species is prevalent during the period July to September. It was at one time considered by us to be a variety of *O. punctum*, and the junior author has published a note under this name, Cuthbertson (1938, P. 118).

9. *Oligopogon penicillatus* Loew.

Loew 1857, p. 350; 1860, p. 93.

A rather scare species which is known in Southern Rhodesia only from the highlands of the Umtali district. The flies occur at the edges of the forests on twigs of shrubs about five feet from the ground, and dart at small midges (Chironomidæ).

The three species of the genus *Oligopogon* Lw. may be separated by the following key: —

1. Hairs of mystax black to brownish black; all bristles and hairs of thorax black; scutellum shining black; abdomen grey dusted 2
- Hairs of mystax whitish; hairs and bristles of thorax forming the acrostichal and dorsocentral rows whitish; scutellum with a grey tomentum; abdomen with grey tomentum, but the hind margins of the segments, and a spot on each tergite shining black; wings hyaline . . . *pollinosus* Engel, (1932, p. 282).
2. Wings wholly dark brown; pleura of thorax with ashy grey tomentum, and shining black stripes on medium and lateral area . . . *nigripennis* Engel, (Engel & Cuthbertson 1937, p. 14).
- Wings hyaline; pleura and metanotum wholly covered with ashy grey tomentum; abdomen with tergites shining black except at sides where they are grey dusted; sternites grey dusted *penicillatus* Loew.

10. *Neolaparus cuneatus* Loew.

Loew 1857, p. 343; Loew 1860, p. 59; Bromley 1936, p. 139.

In S. Rhodesia this species occurs in the highlands of the Eastern districts and Lomagundi. It is prevalent from December to March. In the Vumba Mountains (5,500 ft.) near Umtali, a female was taken during February, 1938, with a winged ant, male, *Rhoptromyrmex globulinodis* Mayr.

Group *Prytaninae*.

11. *Trichardis grisescens* Engel.

Engel 1924, p. 108.

In S. Rhodesia this species is known from the Nyamandhlovu district, Matabeleland, and Urungwe, Lomagundi district. At Kariba Gorge, Zambezi River, it is found on leaf-strewn ground in September. The prey consists of leaf-hoppers and small Hymenoptera, (teste *W. L. Williams*). Rhodesian specimens (males) are much larger than the types which came from Gambia.

Sub.-fam. Asilinæ.

12. *Neolophonotus porcellus* Speiser.

Speiser 1910, p. 102; Engel 1927, p. 158.

This species is prevalent in the Salisbury district from March to May. The flies have been observed on over-hanging twigs of shrubs, on fence wires, and on the stems of tall grasses (*Hyparrhenia* and *Setaria*). Their prey consists of small insects such as leaf-hoppers (*Fulgoridæ*, *Jassidæ*), *Melolonthid* beetles, and moths (*Noctuidæ*, *Pyralidæ*). They make a buzzing noise in flight.

At Stamford Farm near Salisbury in early April, 1938, some larvæ were found in rich humus soil at the roots of large maize plants where they were associated with „white grubs”, the larvæ of *Eulepida mashona* Arrow (*Melolonthidæ*). The larvæ were removed together with soil from their habitat at well as live *Eulepida* grubs, to earthenware pots which were kept in an outdoor insectary. Several larvæ pupated at the surface of the soil on 18th April and a female emerged on 3rd May, 1938. The remaining larvæ and pupæ were preserved and are now in the collections of the Entomological Branch, Agricultural Laboratories, Salisbury. The nature of the food of the larvæ has not been ascertained but it was observed that, in the rearing pots, none of the „white grubs” were attacked. A single larva of *Muscina stabulans* Fln. (*Muscidæ*) was found inside the body of a *Neolophonotus* larva, but the latter was probably dead or dying when attacked. A larva of *Neolophonotus* was placed in a large rearing jar with soil containing a „wireworm”, (the larva of *Trachynotus*), to see if the latter would be attacked. However, it was the *Neolophonotus* larva which was devoured by the wireworm in the absence of plant food! The study of the food of larval Asilids is one which we hope will attract the attention of entomologists in Africa, because apart from the investigation by Melin, 1923, pp. 257—270 in Sweden, no detailed investigations have been made.

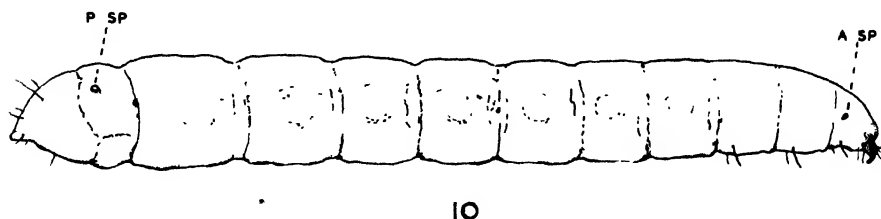
The immature stages

Fig. 10. *Neolophonotus porcellus*, larva: lateral view; A. SP. — anterior spiracle; P. SP. — posterior spiracle.

Larva (Figs. 10—12). Length of mature larva 20—22 mm., breadth 2.0—2.6 mm. on terminal segment, general coloration shining ivory white; body cylindrical, long and slender, composed of head and eleven apparent segments; amphipneustic.

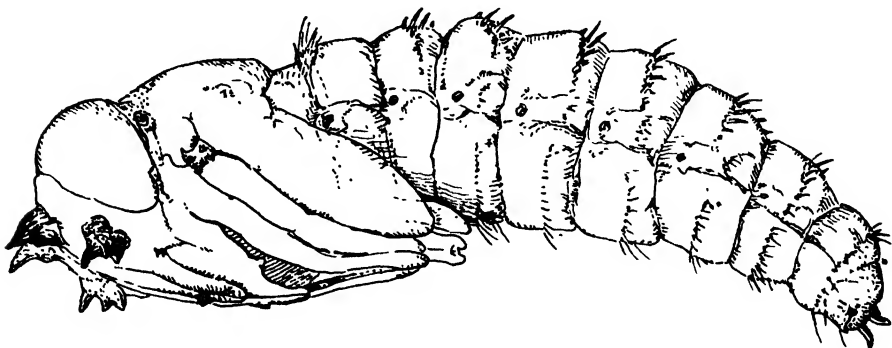


Figs. 11 & 12. *Neolophonotus porcellus*, larva, 11: anterior spiracle; 12: posterior spiracle.

Head: head capsule retractile, of the usual Asiline appearance, sembling that of *Dysmachus forcipula* Zell. figured by Mellin (1923, p. 119).

Thorax: each segment with a long lateral bristle, directed outwards; anterior spiracles (Fig. 11) situated on lateral margin of the prothoracic segment.

Abdomen: dorsal and ventral contractile processes indistinct; lateral swellings or callosities on segments one to seven rather large and conspicuous; terminal segments with an unchitinized, ill-defined, "keel" at apex; anal or posterior spiracles (Fig. 12) on the dorsum of the basal division of the segments, and of the usual multiporous type. On apical division of the anal segment there are a pair of dorsal bristles, a pair of ventral bristles, and two pairs of bristles at the "keel" area, resembling that shown by Melin 1923, p. 163 (Fig. 181) for a European species.



13

Fig. 13. *Neolophonotus porcellus*, pupa: lateral view.

Pupa (Fig. 13). Length of pupal exuvium or skin 14 mm.; breadth at first segment of abdomen 3.5 mm.; general colouration golden yellow.

Head and thorax: one pair of simple anterior "antennal" processes on head, a pair of posterior processes with three "teeth"; sheath of labrum with a dark knob-like process on the middle line; sheaths of posterior legs at coxæ with two dark spines; base of wing sheath with a short dark spine; leg sheaths reaching to end of second segment; thoracic spiracle at hind margin of eye not prominent; dorsum of thorax at the middle with transverse wrinkled area which may be peculiar to species of the *Neolophonotus* group.

Abdomen: eight dorsal transverse rows of pale yellowish spines, large, those on ventral segments smaller; lateral area or "side piece" with six to eight small spines; lateral spiracles oval, not much raised, present on all segments except the anal or terminal segment. The presence of anal spiracles appears to be characteristic of Laphriine pupae so far known from Africa. The pupa of *Hyperichia marshalli* Aust. (Laphriinæ) described by the authors, (Engel and Cuthbertson, 1934, p. 42) has functional anal spiracles, while those of *Proagonistes austeni* Brom. (Laphriinæ) described by the senior author (Engel, 1932, p. 255) are apparently not functional. Malloch 1917, (Pl. 53 & 54) does not illustrate or mention anal spiracles in the American *Asiline* pupæ which he studied.

Systematic Notes.

Rhodesian specimens of *N. porcellus* agree with those from Meru, N.W. Tanganyika, in the Zoologische Staatssammlung, Munich. The key to species of *Neolophonotus* given by the senior author, Engel, 1927, p. 150, should be amended from section 9 as follows:—

9. Bristles on sides of mesonotum white or yellow, or at least some of them 10
Bristles on sides of mesonotum black; bristles on tarsi black 11

10. Tibiæ of fore and middle legs bright yellow with a black apical band; all tarsi with whitish bristles dorsally; tibiæ and femora with mixed black and white bristles. Hypopygium Fig. 18 (*loc. cit.*). Large species 25—27 mm.
robustus Ricardo.

Tibiæ of fore and middle legs brownish yellow, with a black apical band and a ventral stripe; all legs and with long dense yellowish hairs. Hypopygium. Fig. 21. Small species 12—14 mm. Abyssinia . . . *holoxanthus* Hermann in litt.

11. Tibia and some tarsi of fore and middle legs dark brownish yellow; femora somewhat metallic coloured. Hypopygium Fig. 20 *suillus* Fabricius.
Tibiæ of all legs bright yellow with a black band at apex, and with or without a black ventral stripe 12

12. Tibiæ of all legs with broad reddish yellow bases and black apices, with scanty white hairs. Mystax sometimes wholly black. Hypopygium Fig. 17 and 17a *porcellus* Speiser.

Tibiæ ochre yellow with black apices and black ventral stripes Hypopygium
Fig. 19 *orientalis* Ricardo.

13. *Neolophonotus nigripes* Ricardo.

Ricardo 1920, p. 438; Engel 1927, p. 174.

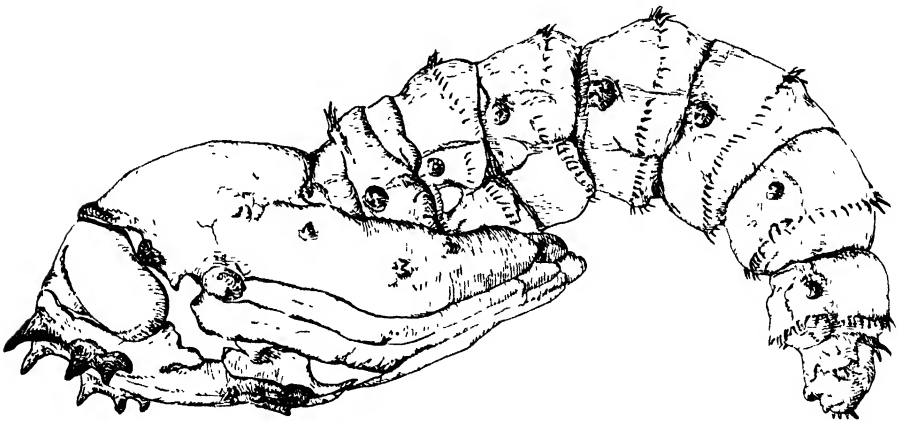
In Southern Rhodesia this species is known from Nyamandhlovu district, Matabeleland, and the highlands of the Umtali district. On the Vumba Mountains (5,000—5,500 ft.), it occurs during February and March among long grass near the edge of kloof forests. The prey consists mostly of small soft-bodied insects such as flies and moths. A female was taken on 27th February, 1938, with a small fly, *Cocnosia semifumosa* Stein, male, (Muscidæ) near the Vumba Hotel, and a male with an ant, *Xiphomyrmex weitzæckeri* Em., male, on 5th Mar. 1938 at the same locality.

14. *Promachus negligens* Adams.

Adam 1905, p. 154; Cuthbertson 1937, p. 17.

In the Hartley and Lomagundi districts this species is common during the late dry season in savannah forest. The flight is direct and swift, the flies making long capture darts at insects which are often of large size, such as cicadas, cockchafers, grasshoppers and Pentatomid bugs. The colour of the eyes of both sexes in life is green.

Regarding the immature stages only the pupa is known at present, having been discovered by W. L. Williams near Gota-Gota camp in the Urungwe sub-district of Lomagundi in September, 1938. The pupa occurred on the surface of sandy soil, the anterior part of



the body protruding from the ground. A female emerged from this pupa on 30th October, 1938. The following description is based on the pupal exuvium or skin, which is preserved in the collections of the Entomological Branch, Salisbury.

Description of Pupa, (Fig. 14). Length of pupal skin 25 mm., breadth measured at base of wing sheaths 7 mm., and 6—4.5 mm. on terminal segment; general coloration dull ochre yellow.

Head and thorax: anterior "antennal" process of head is large, blunt-pointed, the posterior process with three blunt "teeth"; sheath of mouth parts dark brown; sheath of hind legs at coxæ with two dark-pointed spines, the apices of legs reaching almost to the level of the third abdominal spiracle; wing-sheaths short, at base with a blunt process, and with some spine-like processes arranged as in figure. Thoracic spiracles on hind margin of eye kidney-shaped, brown, rather prominent, as noted by Malloch, 1917, p. 383 for an American species.

Abdomen: dorsal transverse row of larger and smaller dark spines on each of the first to seventh segments; spines at sides and on sternites smaller, rather closely set; lateral spiracles large, brown, kidney-shaped and prominent; anal or terminal segment armed at apex with four dark spine-like processes, the dorsal pair larger, anal segment with a pair of median ventral processes and a large blunt process on the under side; terminal segment with a dark mark on each side of dorsum near the transverse row of spines, but no functional spiracles were observed.

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A comparative study of seven species of Transvaal Acrididae, with special reference to the chromosome complex*)

by

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AIM:

The object of this study was to compare the chromosome pictures of several different types of the smaller *Acrididae*. In order to obtain the correct nymphal stages for sectioning, the different species had to be bred in cages. In collecting material for breeding purposes an ecological study of the species was made and this was continued in the breeding cages. During the period in which several generations

*) Submitted in partial fulfilment of the requirements for the degree of M. Sc. in Zoology in the Faculty of Science, University of Pretoria. 1937.

were bred, the details of life-history were also studied. These additional aspects thus increased the scope of the work to a comparison of species belonging to different genera, occurring in the same locality, and of species of the same genus, occurring in different localities, with regard to their morphological, physiological, ecological and chromosomal characteristics.

The genera and species finally selected out of many, the only bias being that they fall into 2 groups, were:

A. Desert type:

a) No outstanding colour variations in each species:

1. *Acrotylus patruelis* H.S.
2. *Acrotylus hottentotus* Sauss.
3. *Acrotylus angulatus* St.

b) Colour variations in the species.

4. *Trilophidia angustipennis* Kirby.

B. Grassland type: colour variations in each species.

5. *Aeolopus thalassinus* F.
6. *Oedaleus carvalhoi* I. Bol.
7. *Oedaleus nigrofasciatus* Deg.

BREEDING METHODS:

After some trials the most efficient type of cage was found to be as follows:

A cage, 12x12x15 inches, of ordinary mosquito wire gauze covered with a finer cotton mosquito-netting to prevent the escape of the small first instar nymphs, provides sufficient space for a maximum of 10 males and 10 females. The cage is without wooden uprights, excepting in front, where 2 uprights support a sliding glass panel, thus providing the maximum amount of light possible in a cage of this type. This top is pegged into a tin, 5 inches high, containing sand obtained from water furrows in the localities where the specimens were caught, this having proved the best medium for the hatching of eggs. The tin is further divided by a central partition so that either side may be moistened separately. Small cages for one pair of individuals consisted of a cylinder of celluloid, with the top covered by means of mosquito netting, resting in sand in an earthenware pot.

The bigger cages were used for mass breeding and the smaller cages were used mainly for testing the possibilities of interspecific

*) The writer is greatly indebted to Dr. B. P. Uvarov of the Imperial Institute of Entomology, London for these identifications.

crossing. The cages were kept indoors, in front of opened windows, in the sun.

Efficient feeding under artificial conditions is the most difficult factor to control in successful rearing and the following methods were tried:

1. *Wild grasses*: Types of veld grasses such as *Setaria* spp., *Panicum* spp., *Aristida* spp., and *Chloris* spp. were cut or dug up and placed in the cages every morning; this method did not prove very successful as these grasses dry out too rapidly, although they are the grasses fed on in the natural state.

2. *Cultivated Gramineæ*: Barley and oats are most readily eaten by all species, but unfortunately proved too coarse for the young nymphs and were thus unsatisfactory, especially in cases where young instars were present in the same cage with adults.

3. *Mixed grasses*: This method in which a mixture of wild and cultivated grasses is fed, has proved the most satisfactory and may be carried out in three ways:

a) The grasses are planted in dishes and when sufficiently grown are placed in the cages. This has not proved satisfactory, because it is difficult to provide a constant supply of growing grass.

b) The grasses are cut off or pulled out and placed in the cages in the morning. Fresh grass keeps several hours and keeps better when pulled out with the roots intact.

c) A bunch of grass is cut and fixed, by means of a cork, into a short test tube containing water. By this means the grass is kept fresh for more than a day, and thus proves the most efficient method in dry and hot weather.

The mixture of grasses fed to the nymphs of different stages consisted of Barley, Oats, *Dactylon* spp. and several of the finer-leaved *Eragrostis* spp., the lastnamed proving very satisfactory.

The egg-packets are deposited in the sand in cages and the hatching of the eggs is accomplished by moistening the soil containing these packets and keeping it moist for a period of 2 to 3 weeks. In the case of the bigger cages with two compartments of sand, each half is moistened once in 3 months, in turn, so that the halves are alternately wet and dry, in order to determine, for each species, whether the eggs are deposited in wet or dry soil.

1. MORPHOLOGICAL CHARACTERISTICS.

The 7 species were studied morphologically as regards: Size, form, colour and sexual characteristics.

A. Size:

Measurements were taken to determine:

1. *External morphological structures*: A thin, flexible and cali-

brated paper strip was used for all measurements and the following important morphological features were measured:

- a) Head, anterior length: taken as from the anterior margin of the vertex of the epicranium to the ventral margin of the labrum.
- b) Head, dorsal length: the length of the vertex of the epicranium.
- c) Thorax, depth: opposite the second pair of legs.
- d) Thorax, length: taken ventrally.
- e) Pronotum: the median dorsal length and the maximum breadth.
- f) Abdomen: length: taken ventrally.
- g) Antennæ: length.
- h) Eyes: taken dorso-ventrally.
- i) Tegmina: the maximum length and the maximum width.
- j) Hind wings: as in the tegmina.
- k) Femur of hind leg: the length and maximum breadth.
- l) Tibia of hind leg: the length.

These measurements are the averages of ten individuals in each case, picked at random. In no case was there a range of variation greatly exceeding 5%, excepting in the length of the abdomen, this being due to its contents or to the results of oviposition. The length of the abdomen was thus taken from individuals killed a few days after the last moult, when the range of variation is approximately 5%. The measurements for the above-named structures are given in Table 1.

2. *Ratios between the sexes*: The sexes differ in size, the female without exception being the larger.

To obtain the ratios for each of the 7 species, body lengths were measured as follows:

- a) The length from the anterior margin of the head to the tip of the abdomen, called body length.
- b) The length from the anterior margin of the head to the tip of the tegmina, with the latter extended straight backwards, called total length.

To obtain comparable results measurements were taken of individuals killed a few days after the last moult when the range of variation in abdomen length is low; later this range of variation is increased due to pairing and oviposition. These body lengths and ratios are given in Table 2.

The conclusions to be drawn from this table are:

- I) The greatest differences between the sizes of the sexes are to be found in *Acrotylus angulatus* and *Oedaleus carvalhoi*.
- II) The smallest differences are found in the species *Acrotylus patruelis* and *Acrotylus hottentotus*.

Table 1: Measurements of external structures, in millimetres

Structure		Acro- tylus patruel- lis	Acro- tylus hottent- totus	Acro- tylus angula- tus	Trilo- phidia angusti- pennis	Aeolo- pus thalas- sinus	Oeda- leus carval- hoi	Oeda- leus ni- grofas- ciatus
Head: anterior length	♀	6.0	5.0	6.0	5.0	6.0	7.0	7.5
	♂	4.0	4.0	3.8	4.0	5.0	5.0	6.0
Head: dorsal length	♀	2.5	2.5	2.5	2.5	3.0	3.0	3.5
	♂	2.0	2.0	2.0	2.0	2.5	2.5	3.0
Thorax: depth	♀	5.0	5.0	5.0	5.0	6.0	6.0	6.5
	♂	4.0	4.0	3.0	4.0	4.0	4.0	5.0
Thorax: length	♀	6.0	6.0	5.5	6.0	7.0	6.5	7.0
	♂	5.0	5.0	4.0	5.0	5.0	5.0	5.0
Pronotum: dorsal length	♀	3.0	2.5	3.0	3.5	4.0	5.0	5.0
	♂	2.5	2.2	2.5	3.0	3.0	3.5	4.0
Pronotum: breadth	♀	3.0	3.0	3.0	3.0	3.5	4.0	4.0
	♂	2.7	2.5	2.5	2.5	2.5	3.0	3.0
Abdomen: length	♀	11	11	10	10	11	11	14
	♂	8	8	7.5	7	8	8	11
Antennae: length	♀	8	7	7	5	6	9	10
	♂	7	6	6.5	5	6	9	10
Eyes: dorsoventral	♀	1.5	1.3	1.2	1.5	2.0	2.0	2.0
	♂	1.2	1.2	1.2	1.2	1.7	1.5	1.7
Tegmina: length	♀	22	22	18	19	23	18	27
	♂	18	18	14	16	18	15	22
Tegmina: width	♀	3.5	3.5	3.5	3.0	3.5	3.5	5.0
	♂	3.0	3.0	2.7	3.0	2.7	3.0	4.0
Hind wings: length	♀	20	20	16	17	21	17	25
	♂	17	17	13	15	17	13	20
Hind wings: width	♀	12	12	9	10	11	9	13
	♂	9	9	7	9	9	7	11
Femur: length	♀	12	12	11	10	12	13	16
	♂	10	10	8.5	8.5	10	11	14
Femur of hind leg breadth	♀	3.0	3.0	3.0	3.5	3.0	3.5	4.0
	♂	2.5	2.5	2.5	2.7	2.5	3.0	3.5
Tibia of hind leg: length	♀	10	10	9	8	10	11	14
	♂	8	8	6.5	7	9	8.5	12

Table 2: Body lengths, in millimetres, and ratios between males and females.

Structure	Acro- tylus patruelis	Acro- tylus hottentotus	Acro- tylus angulatus	Trilo- phidia angustipennis	Aeolo- pus thalassinus	Oeda- leus carvalhoi	Oeda- leus ni- grofasciatus
Body length:							
Head to abdomen ♀	19	19	17	18	22	21	25
♂	16	16	13	15	17	16	20
Length:							
Head to tip of tegmina ♀	27	26	23	24	27	26	33
♂	23	22	18	20	22	21	27
Ratio: Body length	♀ ♂	1.19	1.19	1.51	1.29	1.31	1.25
Ratio: Total length	♀ ♂	1.17	1.18	1.28	1.23	1.24	1.22

III) The smallest individuals amongst all the species are the males of *Acrotylus angulatus*. The largest individuals are the females of *Oedaleus nigrofasciatus*.

IV) Fairly large variations are found among species of a genus.

V) In general the males are longer in relative wing length.

B. Form:

The greatest variations in form, between the 7 species, are found in the head, eyes, pronotum and hind femora.

1) Head:

a) In *Acrotylus patruelis*, *hottentotus* and *angulatus* the vertex of the epicranium is much higher than the dorsal surface of the pronotum; the union of front and vertex is rounded. The eyes are oval in outline.

b) In *Trilophidia angustipennis* the vertex is also rounded but not much higher than the dorsal surface of the pronotum; the union of the front and the vertex is also rounded. The eyes are oval in outline.

c) In *Aeolopus thalassinus* the vertex is only moderately rounded and at about the level of the dorsal surface of the pronotum; the front recedes well. The eyes are mussellike in outline.

d) In *Oedaleus carvalhoi* and *nigrofasciatus* the vertex is also only moderately rounded and the front recedes only moderately. The eyes are more oval than mussellike in outline.

2) Pronotum:

a) In *Acrotylus patruelis*, *angulatus* and *hottentotus* the prono-

tum is saddlelike, only flatter in *A. hottentotus* and more concave in *A. angulatus* than in *A. patruelis*.

The dorsal posterior part is flattened in all three species and carries a slight median carina. The dorsal posterior edge is rounded.

b) In *Trilophidia angustipennis* the pronotum is also saddlelike but with a sharp, anteriorly double-notched carina. The dorsal posterior edge is angular.

c) In *Aeolopus thalassinus* the pronotum is flatter dorsally and very slightly keeled. The dorsal posterior edge is the somewhat between a rounded and an angular outline.

d) In *Oedaleus carvalhoi* and *nigrofasciatus* the median keel of the pronotum is more prominent than in any of the other species. The dorsal posterior edge is angular.

3) Hind legs:

The main difference shown by the species is in the proportion of narrowing of the femur. In *Aeolopus thalassinus*, *Oedaleus carvalhoi* and *Oe. nigrofasciatus* the femur width is carried down further towards the tibia than in the other species. In all the species the stridulating organs are the inner surfaces of the hind femora and the basal third of the thickened radii of the fore-wings.

C. Colour:

Great variations are found in colour, inter-specific and intra-specific.

1. General:

In all cases coloration is double: the ground colour being overlaid by secondary spots, patches or tinges. The ground colour seems to be the most liable to variation; in all species with a ground colour of cream, creamy yellow, orange or creamy light brown, this colour seems to have dulled after four generations in the cages to a greyish yellow, a light fawn or a grey.

In the following descriptions of the different species the colours are given as observed in specimens in their natural surroundings.

a) In the *Acrotylus* species the ground colour is a dark cream with a faint purplish tinge, the whole more or less obscured by a mottled brown. In *Acrotylus hottentotus* the ground colour is lighter than in the other two species, with the purplish tinge even more faint and the brown patches paler. In *Acrotylus angulatus* the ground colour is brighter than in the other two species and in addition 2 colour variations are found: firstly a variation with the anterior dorsal parts of the body more lightly coloured, this variation being indicated in the nymphal stages by a whitish stripe running, dorsally, for the length of the body; secondly a variation with the whole pronotum coloured green.

b) In *Trilophidia angustipennis* two definite colour variations

are found in the natural environment. Firstly, a variation with the ground colour of a creamy brown covered with brown and dark brown patches, giving an impression of light brown. Secondly, a variation with the ground colour of a light reddish brown, covered with light brown, brown and reddish brown patches, giving an impression of reddish brown.

c) In *Aeolopus thalassinus* two definite colour variations are found. Firstly, a variation with the ground colour of a dark cream with a faint purplish tinge and a few brown spots. Secondly, a variation with a light green coloration on the following parts: the front, genæ and epicranium of the head, the pleura of the thorax, the dorso-lateral and postero-lateral parts of the pronotum, the anterior basal parts of the tegmina and the lateral parts of the hind femora.

d) In *Oedaleus carvalhoi* and *nigrofasciatus* the ground colour is a creamy light brown, in the first covered with faint dark spots and in the second with a darker tinge and the spots merging into patches. In both species a colour variation is found: a light green appearing on the frons and epicranium of the head, on the pleura of the thorax and the carina and posterior lateral parts of the pronotum, and on the posterior parts of the tegmina and the upper edge of the hind femora.

2. Head:

The head generally shows a coloration similar to that of the body.

a) In *Acrotylus* species the head is somewhat lighter in colour than the rest of the body, excepting in *A. angulatus*, where it is either the same colour or very much lighter — this lighter creamy colour running from the genæ and epicranium on to the dorsal parts of the pronotum. The antennæ of all three species are light brown near the base, running into a darker brown near the tip. The eyes differ in coloration; in *A. patruelis* they are mottled with dark brown, in *Acrotylus hottentotus* the light brown is only slightly speckled with a deeper tinge and in *A. angulatus* the colour is darker brown only along the lower periphery.

b) In *Trilophidia angustipennis* the head is coloured like the rest of the body. The antennæ have alternating circles of light and dark brown. The eyes are buff, speckled with brown and in most specimens the lower half is darker than the upper half.

c) In *Aeolopus thalassinus*, *Oedaleus carvalhoi* and *Oe. nigrofasciatus* the colour of the head is more or less like that of the rest of the body. The antennæ in all three species are light coloured and darken slightly towards the tip. The eyes of *Aeolopus thalassinus* are mottled with dark brown while in *Oedaleus* spp. they have the colour of the body.

3. Pronotum:

The greatest intra-specific variation in coloration is found in the pronotum.

a) In *Acrotylus patruelis* the dorsal parts are brown and the lateral parts a light purplish cream with brown patches.

In *A. hottentotus* the dorsal parts are a lighter brown and a light-coloured spot, on each side, shows more distinctly than in the former species. In *A. angulatus* the ground colour of the dorsal parts is light brown, with 2 whitish spots on either side — one near the carina and one more lateral. In this species 2 variations are found; firstly, with the dorsal pronotal area more lightly coloured and secondly, with the whole pronotum a light green.

b) In *Trilophidia angustipennis* the pronotum has the same colour as the body.

c) In *Aeolopus thalassinus* the pronotum is coloured like the general body colour but with 2 brown-dotted stripes running on the dorsal parts towards the head.

d) In *Oedaleus* spp. the pronotum is a light brown with a brown stripe on either side of the carina, running towards the eyes and in each stripe 2 whitish lines nearly meeting to form an obtuse angle with the apex towards the carina; in *O. nigrofasciatus* the anterior of these lines seems to contact with similar lines on the head, running towards the eyes.

4. Hind wings:

A fair amount of inter-specific variation is found in the coloration of the hind wings.

a) In *Acrotylus patruelis* the basal half is light red, the distal part more or less transparent, with dark brown veins and a dark brown crescent following the light red but not passing over the costal area of the wing. In *A. hottentotus* the coloration is similar, but the dark brown crescent passes slightly on to the costal area. In *A. angulatus* the basal half is a light yellow, the distal part more or less transparent, with dark brown veins and a dark brown crescent next to the yellow, not passing over the costal area of the wing.

b) In *Trilophidia angustipennis* the basal half is a light yellow, the remainder being a dusky brown.

c) In *Aeolopus thalassinus* the hind wings are more or less transparent with dark brown veins.

d) In *Oedaleus* spp. the basal half is light yellow, next to it there is a dark brown crescent over the cubital and anal areas, except in *Oc. nigrofasciatus* where it passes over the whole width of the wing; the distal parts are more or less transparent with one or two brown spots at the apex.

5. Abdomen:

The abdomen has the same ground colour as the body in all the species, excepting in *Acrotylus angulatus* where it has a deeper purple tinge and in *Trilophidia angustipennis*, where it is mottled like the rest of the body.

6. The nymphal stages:

The first instar nymphs attain their differentiating colours within a few hours after hatching; These colours gradually change into the adult colours during the consecutive stages.

a) *Acrotylus* spp. have a ground colour of light creamy brown colour. In *A. patruelis* darker brown is found dorsally, especially over the thorax and the front half of the abdomen; the eyes are dark. In *A. hottentotus* a dark brown covers the labrum, clypeus, epicranium and genæ and the lateral parts of the thorax; the eyes are lighter in colour than in the former species. In *A. angulatus* a dark brown covers the labrum and lower parts of the genæ and dark patches run laterally along the thorax and the abdomen; the eyes are similar in colour to those of the former species.

b) In *Trilophidia angustipennis* the first instars nymphs are light brown, with dark brown hind femora and tibiæ; this body coloration is more yellowish red in the case of the reddish brown variation. The eyes vary from light to dark.

c) *Aeolopus thalassinus* has a creamy colour, with the anterior parts more light creamy brown; the eyes are dark.

d) In *Oedaleus* spp. the ground colour is cream, with the head more cheese coloured and with brown dots along the sides of the body; the eyes are of a brownish colour.

7. Breeding experiments with colour variations:

Since the object of these investigations was not primarily a genetic study of colour variations and since the facilities were somewhat inadequate for individual tests, i.e. rearing a single male and a single female together in a cage, the results thus far obtained are for mass-breeding, i.e. the progeny were removed and placed in a separate cage before the last moult. Thus in the case of the F_1 and F_2 generations „mixed” breeding may have resulted, to further invalidate any conclusions. Most species have now passed into the 5th generation and thus 4 consecutive generations have been reared in the cages.

a) Colour variations in *Trilophidia angustipennis*.

The 2 colour variations *) started with were: „light brown” and

*) Other colour variations also appeared, but due to the nature of this study the course of these variations has not been followed. The following are the variations:

I) Through a mating of grey and red-brown individuals there appeared a

„red-brown”. Through a mating of these two there appeared a 3rd form, viz. a light grey with brown patches, here designated as „grey”. Through a mating of grey and red-brown individuals there appeared a 4th form viz. a greyish fawn with brown and dark brown patches, here designated as „grey-brown”. The results given in table 3 have thus far been obtained.

Table 3: Results of testing colour inheritance in *Trilophidia angustipennis* Kirby.

Cross	Generation	Packets Hatched	Number of Individuals	
1. Red-brown \times red-brown	F ₁	6	54	<div> <div>Red-brown</div> <div>Light brown</div> <div>Grey</div> </div> <div>42</div> <div>10</div> <div>2</div>
Red-brown F ₁ \times red-brown F ₁ . . .	F ₂	4	29	<div> <div>Red-brown</div> <div>Light brown</div> </div> <div>20</div> <div>9</div>
Red-brown F ₂ \times red-brown F ₂ . . .	F ₃	4	27	<div> <div>Red-brown</div> <div>Light brown</div> </div> <div>20</div> <div>7</div>
Red-brown F ₃ \times red-brown F ₃ . . .	F ₄	2	18	<div> <div>Red-brown</div> <div>Light brown</div> </div> <div>13</div> <div>5</div>
2. Light brown \times light brown . . .	F ₁	5	36	<div> <div>Light brown</div> <div>Grey-brown</div> <div>Grey</div> </div> <div>32</div> <div></div> <div>4</div>
Light brown F ₁ \times light br. F ₁ . . .	F ₂	5	41	<div> <div>Light brown</div> <div>Grey-brown</div> <div>Grey</div> </div> <div>36</div> <div></div> <div>5</div>
Light brown F ₂ \times light br. F ₂ . . .	F ₃	1	8	<div> <div>Light brown</div> </div> <div>8</div>
		5	43	<div> <div>Light brown</div> <div>Grey-brown</div> <div>Red-brown</div> <div>Grey</div> </div> <div>38</div> <div></div> <div>4</div> <div>1</div>
		5	40	<div> <div>Light brown</div> <div>Grey-brown</div> <div>Red-brown</div> </div> <div>34</div> <div></div> <div>6</div>

few individuals in the progeny with the ground colour either grey or red-brown, but with this colour almost totally obscured by brown and sepia patches, thus dark individuals.

II) In the first generation of breeding individuals of the light brown type together there appeared a few individuals in the progeny with a few distinctly red-brown patches: one on the epicranium, one each on the two points of the doubly notched carina, one on the posterior dorsal angle of the pronotum and one each in the middle of the outer surfaces of the hind femora. A percentage of red-brown individuals also have these distinctive patches.

Table 3 (continued).

Cross	Generation	Packets Hatched	Number of Individuals		
3. Grey \times red-brown	F ₁	2	21	<div> <div> Light brown Grey-brown Red-brown Grey </div> <div> } </div> </div> 11 4 6	
		2	19	<div> <div> Light brown Grey-brown Red-brown Grey </div> <div> } </div> </div> 11 6 2	
<div> <div> Light brown F₁ Grey-brown Grey </div> <div> } </div> </div>	<div> <div> light br. F₁ grey-brown grey </div> <div> } </div> </div>	F ₂	1	8	<div> <div> Light brown Grey-brown Red-brown Grey </div> <div> } </div> </div> 6 1 1
		5	38	<div> <div> Light brown Grey-brown Red-brown Grey </div> <div> } </div> </div> 30 4 4	
4. Grey \times grey-brown	F ₁	4	30	<div> <div> Light brown Grey-brown Grey </div> <div> } </div> </div> 24 6	
Grey-brown F ₁ \times grey-brown F ₁	F ₂	2	20	Grey-brown 20	

Observations to be made on Table 3 are:

I) The difference between the variation called grey and the variation called grey-brown is readily discernible; however there is, however, no clear-cut difference between the colour variation called grey-brown and the variation called light brown. In the latter case the two types seem to merge into one another.

On the other hand no males of the grey type have been found to belong much more distinctively to the type called grey than to the grey-brown type, although a fair number of females have definitely shown a grey ground colour.

II) In the last two hatchings of 43 and 40 in the F₃ generation of the light brown \times light brown, half the females used to produce these hatchings were taken from the F₂ generation of the red-brown \times red brown cross.

III) Very dark greys, light browns and red-browns, that is individuals with the ground colour almost obscured, have appeared in the F₁ and F₂ generations of the grey red-brown cross.

IV) The first appearance of individuals with the distinctive series of reddish brown spots, previously mentioned, was unfortunately not observed.

V) The results thus far obtained do not support a single-allelomorphic hypothesis; a multiple factor complex may be possible, although there is no accumulative series of colour variations in the adult.

VI) Both reddish brown and light brown types may be heterozygous.

Thus three possibilities seem the most likely: Firstly, a multiple-allelomorphic difference. Secondly, light brown a dominant allelomorph, with reddish brown a separate dominant conditioner. Thirdly, light brown a dominant allelomorph with reddish brown a separate accumulative allelomorph. Thus at least two pairs of factors may determine colour, and they may be linked or not.

VII) The overlaid colour, viz. the patches and spots, may depend on a third factor, if the very dark individuals have any implication.

VIII) All results are however relative, due to the fact that only about 80 % of nymphs were reared.

IX) According to Rubtzov the tendency to phase variation observed in gregarious species should also be expressed in non-gregarious grasshoppers, as colour variability has been determined as a homologous series in many Acrididæ (1: Rubtzov, 1935). Rubtzov proved this in the case of a species that is very active and may form dense populations and found similar results for other species of the same type; the method used was that of crowding individuals, so that changes resulted during individual life. According to Rubtzov the greater the density of population, the greater the percentage of blackish-brown forms. The following remarks may be made on these findings, as regards *Trilophidia angustipennis*:

This species is very inactive and very scattered in its natural habitat; only the two colour variations, viz. light brown and red-brown are found. Crowding either of these two variations, separately, caused no change towards one or the other type. It was during the period when the population of the cages was at its densest, viz. at the rate of about 800 individuals per sq. metre, that the dark coloured individuals mentioned in the footnote were observed for the first time; also the individuals with the conspicuous red-brown markings.

b) Colour variations in Aeolopus thalassinus.

In this species the ground colour is either a creamy light brown or a green. The green however is found only over parts of the body, as described above.

The results thus far obtained in testing inheritance of colour in this species are given in table 4.

*Table 4: Results of testing colour inheritance in *Aeolopus thalassinus* F.*

Cross	Generation	Number of Individuals	
Light brown \times light brown.....	F ₁	60	Light brown 60
F ₁ \times F ₁	F ₂	45	Light brown 45
F ₂ \times F ₂	F ₃	90	Light brown 90
Green \times green	F ₁	84	Light brown 84
Light brown F ₁ \times light brown F ₁	F ₂	60	{Light brown 57 Green 3
Green \times light brown... ..	F ₁	35	{Light brown 34 Green 1

This species was the easiest to rear, the mortality very low i.e. less than 10 % and the period of maturing short, so that the very small percentage of green individuals indicates the influence of the environment if any genetic allelomorphous factor hypothesis is tenable.

Supported by observations on this species in the natural environment, the following observations may be made on the results obtained in table 4:

I) The green colour form is scarce, certainly less than one individual out of every fifty observed.

II) Green males are even more scarce than females, the more common types found having no green on the tegmina and very little on the thorax.

III) The green colour form seems more abundant in early summer, though still surpassed by the brown colour form in numbers.

IV) The green colour forms produced in the breeding tests first showed their green coloration in the 2nd instar, when the whole body was coloured green.

V) Certain, if not all, green individuals darken to brown during sexual maturity.

Such was the case with the 3 green females obtained in the breeding tests in Table 4; one female slowly darkened and after 3 months in a single cage showed the ordinary brown colour of the species, while the others changed quickly to the ordinary brown colour, within 3 weeks after the final moult.

VI) On the other hand some green individuals caught and placed

in the cage retained the green colour for the duration of their life.

VII) These facts, at any rate, seem to show that the green colour variation is not due to a coloured background, high humidity and abundant green food, as found by Faure in several species of migratory locusts (² Faure, 1932). Green and brown individuals were kept by themselves in cages with a green curtain for background, with the soil continuously wet and succulent green food supplied daily; none of the brown forms changed to the green colour, but some green individuals as remarked, changed to the brown colour form.

c) Colour variations in Acrotylus angulatus.

No special breeding tests were undertaken with this species, but certain observations were made:

I) In the second and third generations in the cages a small percentage of individuals were of the light-coloured type, viz. a very light cream on the genæ, epicranium and pronotum; this characteristic is clearly recognisable in the first instar and is correlated with a light colour over the terga of the abdomen.

II) The colour variation with the green pronotum is very scarce and no individual of this type has been bred. During 2 years of collecting and observation only 3 individuals have been observed, all three being females. The writer intends to breed these variations on the hypothesis that they are recessive to the ordinary light brown coloration.

d) Colour variations in Oedaleus carvalhoi and Oe. nigrofasciatus:

Here also the brown and green colour forms are found, the latter being less common than the former. Colour inheritance tests were carried out but were inconclusive due to the high mortality, i. e. up to 40 %. However, through three generations, with a large number of hoppers hatching, not a single green individual has appeared *), not even in cases where green individuals were mated. As in the case of *Aeolopus thalassinus*, these species also have the green females more abundant than the green males; on the other hand, the green colour form, although less abundant than the brown

*) After the above was written 2 individuals out of 67 of the later hatchings of the 3rd generation of *Oedaleus carvalhoi*, took on the green coloration in their third instars. These are the only green individuals that have thus far appeared in the cages in the three generation that have been bred.

The environment is approximately the same in all the cages, so that green colour seems developed either by a complex of recessive factors or influenced by a single factor in the environment. In the case of both *Aeolopus* and *Oedaleus* spp. it is evident that either the environment or an unknown factor is the main activator for green colour.

colour form, is found as a more or less constant percentage throughout the year.

D. Sexual characteristics:

a) External characters:

As the figures in Table 2 show, there are differences in size between the males and females of each species; although the degree of difference varies between the species.

As regards the posterior abdominal parts, the females of all species are similar in that the terga of the 9th and 10th segments are not completely separated ventro-laterally, in that the 11th tergum of supra-anal plate is only slightly grooved laterally and in that the ovipositors are very similar, each consisting of 3 pairs of typical valvulæ.

The males are also very similar and have the 9th and 10th terga more or less completely divided.

b) Internal characters:

There seem to be slight variations inter-specifically in the gonads, in the number of ovarian tubes and testicular follicles, although those of the compound testis vary more than those of the ovaries. Table 5 gives the common number for each species, from examination of from 10 to 20 specimens of each sex, the figures for the males are based on both gross dissection and microtome sections.

Table 5: The number of tubes and follicles in the gonads of the 7 species.

Gonad	Acro- tylus patruelis	Acro- tylus hottentotus	Acro- tylus angulatus	Trilo- phidia angustipennis	Aeolo- pus thalas- mus	Oeda- leus carval- hoi	Oeda- leus nigrofasciatus
2 Ovaries	28	26	14	18	32	36	30
Compound testis . . .	34	24	26	18	36	30	36

Observations to be made on this table are:

I) The figures given are more in the nature of modal numbers than averages, as out of the number of specimens examined for each species, only one or two show any divergence from these numbers, with a range of variation, generally, of 2.

II) Inter-specific variation is great, as seen from the data; it is difficult to distinguish between males of *Acrotylus patruelis* and

A. hottentotus externally, yet the anatomy of the gonads shows a vast difference.

III) Throughout, intra-specifically, the sexes differ in the number of follicles in the gonads, excepting in the case of *Trilophidia angustipennis*.

In the case of this species, a fair number of the females have 20 follicles, while several males have been observed to possess a full complement of 17 follicles, an odd number not once observed in any of the other species.

II. PHYSIOLOGICAL CHARACTERISTICS:

A. Sexual maturity:

The differences in the relative rate of maturity of the gonads seem not to be as much a difference of species as of difference of groups. If comparison of the slides of the cytological work can be utilized as a means of calculation of stage of sexual maturity in the males, then the following results are valid:

1. *The desert group:*

In the case of *Acrotylus* spp. and *Trilophidia angustipennis* half the number of slides cut of a testis, still show meiotic divisions, if the specimens are dissected one day after the last moult. The other half of the follicular lengths would then contain only spermatids and spermatozoa.

This desert group, in its natural environment, is more exposed to the sun, and thus to higher temperatures.

Of this group *Trilophidia angustipennis* is the most rapidly maturing since specimens dissected in the 5th instar already show fully developed sperm in up to one quarter of the follicular lengths.

2. *The grassland group:*

In the case of *Oedaleus* spp. and *Aeolopus thalassinus*, as many as three-quarters of the number of slides cut of a testis still show meiotic divisions, if the specimens are dissected one day after the last moult. The members of this group therefore seem to mature later in the life of the individuals than those of the desert group. The grassland group is better protected by shade in the heat of the day. In the case of females, the maturity of the gonads is exemplified by the stage of development of the ova, has not been studied in the various species. In general maturity seems to be reached after the last moult, as no female has been dissected, a few days after the last moult, which has ova in any greatly advanced stage of development.

B. Copulation:

Accurate observation of the first copulations after moulting were somewhat difficult, due to the fact that the ten or so individuals

in a cage do not pass through their final moult on the same day and to the further fact that the period of copulation is not long. But in certain cases, especially in the small cages, observations could be made.

1. *Trilophidia angustipennis*:

In this species the following observations were made: A light brown female passed through the final moult on 1—7—1935 and paired on 14—7—1935. Another moulted finally on 11—1—35 and paired on 30—1—35. A third passed through the final moult on 27—12—1934 and laid fertile eggs, which hatched out on 12—1—1935. These figures show that copulation may take place in this species within 2 weeks after the last moult.

2. *Acrotylus* spp.:

Individuals of these species have been observed to pair, but after a longer period after passing through the last moult — about 1 month on the average, in both males and females.

3. *Aeolopus thalassinus*:

In this species only one case has been accurately determined, when pairing took place 1 month after passing the last moult, in both the male and the female.

4. *Oedaleus* spp.:

No clear case has been observed, but since the first hatch generally occurs about 3 months after the last moult, pairing may take place for the first time between individuals one month after they pass the last moult.

Recurrence of copulation has been observed up to 2 months after the first; this has been definitely observed in the case of a male and female in a colour-cross in *Trilophidia angustipennis*.

C. Oviposition:

No comparisons were made between all 7 species; however the following observations were made:

1. *Period elapsing between last moult and first egg-laying*:

Oviposition seems to take place shortly after the first copulation; for example, a *Trilophidia angustipennis* female passed through the last moult on 27—12—1934, paired, and oviposited on 12—1—1935 and was seen to pair again a month later. Oviposition in the mass-breeding cages continues for a period of several months after the last moult.

As regards the season of oviposition this has been observed:

a) In *Acrotylus* spp. from August to May. b) In *Trilophidia*

angustipennis during the same period. c) In *Aeolopus thalassinus* throughout the year. d) In *Oedaleus* spp. from October to April, although in a few cases also in July and August.

These are all, however, under artificial conditions in the cages, i.e. protected from wind, with the stimulation of an equable climate.

In their natural environment all species are most common in the hopper and early adult stages from September to the end of April, so that the chief egg-laying season appears to be in the summer rainy season.

2. Method and place:

The method followed by all species, is that by which the female bores into the soil by means of her ovipositor, opening up a tunnel which is generally about 2 inches deep, then depositing the eggs in a packet, and finally covering their tops with a foamy secretion to within a short distance of the soil surface. In the natural environment the top is then further covered by a shallow layer of soil grains, due to the action of winds, etc.

All species oviposit in the sand provided in the cages. generally near to the lower supporting bars of the wire netting. This agrees with the natural habitat, where oviposition generally takes place next to a grass sod. Oviposition in the dry soil has been observed in all 7 species but it has also been observed in moist soil:

Acrotylus patruelis and *A. hottentotus* have been observed to oviposit in soil, 4 days after it has been moistened, while still wet; *Oedaleus nigrofasciatus* also a few days after moistening the soil; *Acrotylus angulatus* and *Aeolopus thalassinus* have been observed to oviposit in a fairly moist Bradley grass lawn, and *Trilophidia angustipennis* has been inferred to oviposit in moist soils, when considering the incubation periods. Only *Oedaleus carvalhoi* has never been observed to oviposit in moist soil.

The depositing of egg-packets loose on the surface of the soil or against the sides of the cage has been observed in all species, especially during July and August, but also during other months.

These may be unfertilized eggs, as none of the egg-masses have hatched when carefully buried and moistened.

3. The number of egg-packages laid by one female:

This fact has not been determined, but taking into consideration the numbers of hatchings in cages with only one or two females, the probability is that a female may deposit more than 2 packets.

D. Life cycle:

Four to five consecutive generations have been reared in the case of each species and the following particulars have been ascertained:

1. *Period of incubation:* This period varies, but the range of variation is greater inter-specifically than intra-specifically, perhaps due to temperature and moisture conditions.

a) *Acrotylus* spp.: For these species the time taken for the eggs to hatch kept indoors but in the sun varied from 3 weeks in summer to 4 weeks in autumn. The averages for more than 12 hatchings for each species, with from 1 to 6 packets per hatching, were: *A. patruelis*: 24 days in summer, 30 days in autumn. *A. hottentotus*: 22 days in summer, 28 days in autumn. *A. angulatus*: 22 days in summer, 28 days in autumn.

b) *Trilophidia angustipennis*: for 21 hatchings with from 1 to 3 packets per hatching the averages were: 24 days in summer, 30 days in autumn.

c) *Aeolopus thalassinus*: for 13 hatchings with from 1 to 4 packets per hatching, the averages were: 21 days in summer, 30 days in autumn.

d) *Oedaleus* spp.: for more than 12 hatchings, with up to 5 packets per hatching, the averages were: 17 days in summer, 26 days in autumn.

The species living in localities or areas which are more moist and have more equable conditions, such as better covering of veld, seem to oviposit eggs that develop more rapidly in the warm season but more slowly in the cold season.

The type of water applied seems to be important in incubation; rainwater has consistently given good results but temporary hard tapwater used in the beginning proved less efficient, giving the hatching of only package of eggs of *Oedaleus carvalhoi* among approximately 50 packages laid by the different species. This was determined by digging up the sand and counting the decayed egg-packages. Whether this fact was due to the calcium carbonate deposited on the egg-shells is not certain; but when tapwater, very weakly acidified with hydrochloric acid, was used, more hatchings were obtained, viz. 3 out of about 20 egg-packages of *Oedaleus carvalhoi* and 2 out of 16 egg-packages of *Aeolopus thalassinus*.

2. *Number of eggs per packet:*

The number of eggs laid per packet has been determined in all the species; this determination has been controlled by counting the number of discarded egg-shells, and by dissecting females with developed ova.

The results of this controlled calculation are given in table 6.

Table 6: Number of eggs hatched and developed ova dissected:

Species	No. of Ovarian Follicles	No. of developed Ova in ovaries	Hatchings observed	
			Egg-packets	Eggs per packet
<i>Acrotylus patruelis</i>	28	10—14	24	10, 12, 14
<i>Acrotylus hottentotus</i>	26	10	25	8, 10, 12
<i>Acrotylus angulatus</i>	14	10	28	8, 10
<i>Trilophidia angustipennis</i> ..	18	8—10	50	8, 10
<i>Aeolopus thalassinus</i>	32	12	30	7, 12, 14
<i>Oedaleus carvalhoi</i>	36	12	24	12, 14, 16
<i>Oedaleus nigrofasciatus</i>	30	18	—	16, 18

Observations to be made on this table are:

I) In the second column are given the number of developed ova found in both ovaries in a large number of dissections; in the cases where no range of variation is indicated, no common variation was found, i. e. all ovaries had 12 (or 18) eggs.

II) In the cases of species with a large number of ovarian follicles, approximately every alternate follicle had a fully developed ovum — the capacity of the body cavity probably causing this limitation.

III) In the third column are given the numbers of egg-packets observed for each species.

IV) In the fourth column are given the numbers of eggs hatched per packet; on the average equal percentages of each number for the amount of egg-packets given in column 3, eg. more or less equal numbers of 10's, 12's and 14's for the 24 egg-packets of the 1st species. In the case of *Aeolopus thalassinus* and *Oedaleus carvalhoi* there appears a discrepancy, perhaps due to the fact that by chance females with the higher numbers of eggs hatched per packet were not examined in compiling the data for column 2.

Very often hatchings occurred of 2, 4, 7 etc. individuals. The figures given, however, constitute a high percentage of hatchings.

E. Duration of nymphal development.

The determination of the development period, under artificial conditions, does not yield results of any importance unless it be made a special study, aided by apparatus for simulating the climatic conditions of the natural environment.

The following factors seem to have a direct influence on the duration of the nymphal stages:

1. Temperature.

2. Humidity of the atmosphere.
3. Type of grass fed on in the natural environment.
4. Condition of the cut grass fed.
5. Restriction of movement.

A further complication is the duration of the nymphal stages — individuals of the same hatching showing a range of variation. In table 7 are given the approximate results obtained, on the average, over 3 generations.

Table 7: Duration of nymphal life: From hatching until the last moult

Species	Summer generation	Winter generation
<i>Acrotylus patruelis</i>	60 days	100 days
<i>Acrotylus hottentotus</i>	47—54 days	90 days
<i>Acrotylus angulatus</i>	43—51 days	85 days
<i>Trilophidia angustipennis</i>	53—57 days	90 days
<i>Aeolopus thalassinus</i>	43—58 days	70—98 days
<i>Oedaleus</i> spp.	60 days	117—120 days

F. Duration of life of the adult:

The factors influencing the duration of the nymphal stages would also influence the duration of life. The general duration has however been noted and is somewhere in the region of six months, although individuals, here and there amongst the species, have been noted to live up to 200 days. On the average the adults of *Aeolopus thalassinus* have the shortest period of adult life, not attaining more than about 5 months.

G. Number of generations per annum:

The fact that each generation lives for about half a year, shows the possibility of rearing two generations per annum.

This has been accomplished, because in all species hatching has taken place in September; this generation oviposited and the hatchings of the second generation took place in March and April. This latter generation then passes through its nymphal stages and is ready to oviposit in September and October. Two generations may also be found in the natural habitat, depending on the rainfall, as the nymphs were observed early in the summer and also late in autumn.

H. Parthenogenesis:

No definite case of parthenogenesis has been observed, although females of all the species have been kept isolated without males, in

order to determine whether is possible. In such cases eggs have been laid loose on the surface, but no hatching ever occurred, except the case mentioned in J₃ as being possible parthenogenesis.

I. Fertility:

The relative fertility of the different species has not been determined, although the following facts have been determined.

1. On the average the same number of males and females were kept in each cage; the total number of hatchings were also approximately equal for all the species.

2. No harmful effects resulting from lengthened nymphal stages have been observed, such as, for example, abortion of gonads or loss of fertility. The duration of the winter nymphal stages was considerable longer in winter than the corresponding period for the summer generation, yet the number of hatchings from the winter generation was not reduced (³ Sansome and La Cour, 1935).

J. Evidences of natural cross-breeding:

Trials were made in natural interspecific crossing of the three species of the genus *Acrotylus* and the two species of the genus *Oedaleus*. In each genus the males of all the species were single-caged with the virgin females of all the other species, with the following results:

1. Not a single copulation between different species has been observed and neither an instance of oviposition in the sand. On the other hand, these phenomena, if infrequent, are only observed by chance.

2. In a cage containing 2 *Acrotylus patruelis* females and 2 *A. angulatus* males, egg-masses have thrice been observed on the soil. These did not hatch when buried, so that they possibly were unfertilized.

3. In this same cage, at a later stage, 2 nymphs hatched out. This hatching was controlled by finding the two empty egg-shells on the surface of the soil. The two 1st instars were subnormal in size: although resembling the newly hatched 1st instars of *Acrotylus patruelis*, they were approximately only three-quarters the usual length, in fact were so small that they could pass through the fine-meshed netting surrounding the cage. These two individuals lived for only a week, notwithstanding the care taken in the provision of suitable food; thus no tests could be made to determine their origin.

4. The two species, *Acrotylus patruelis* and *A. hottentotus*, are so similar externally that identification is most difficult, yet no case of crossing was observed, although up to three females of the one and three males of the other were kept together. On the other hand, the result obtained in point 3 is important, as indicating either

parthenogenesis, or crossing, and artificial insemination methods are now being studied in the attempt to solve this problem.

III. ECOLOGICAL CHARACTERISTICS:

A. Habitat:

As has been noted above the seven species may be grouped into two types: the desert i.e. arenicolous type, comprising *Acrotylus* spp. and *Trilophidia angustipennis*, and the grassland type, comprising *Oedaleus* spp. and *Aeolopus thalassinus*.

1. *Acrotylus patruelis*: Observed in the districts of Pretoria, Waterberg, Potgietersrust and Pietersburg. In these areas the natural habitat is open sandy areas in grass plains, in the neighbourhood of sparse sod grass. The nymphs are found amongst the grasses, while the adults, when not feeding, select open sandy spaces, where they burrow slightly into the loose sand. Using the first two pairs of legs to scrape up the sand, they lie in the sand with only the dorsal parts of their bodies appearing on the surface. This species does not seem to move far from the spot at which the hatching took place, as in areas of approximately 20 sq. yds. sufficient males and females have been observed and caught, to account for one or more hatchings.

2. *Acrotylus hottentotus*: This species has only been observed in the southern Transvaal, for example the Pretoria and Witwatersrand districts. Its natural habitat is similar to that of the former species, only perhaps more open; however in no case have these two species been observed in the same locality. Except while feeding, individuals of *A. hottentotus* have always been observed in open patches of reddish, sandy soils on grass plains, basking in the sun. They have also been observed to dig themselves into the soil, to such an extent however, that only the vertex antennæ and eyes appear on the surface.

This species also seems not to move far from the spot where the individuals are bred.

3. *Acrotylus angulatus*: This species has been observed over a large area, from the northern to the southern Transvaal. The common type was caught in both the Potgietersrust and Witwatersrand districts, while the variation with green pronotum was observed only in the Potgietersrust district and the variation with the light coloured pronotum, etc. was caught in the Witwatersrand district.

This species is found in a habitat, slightly better covered with vegetation than is the case with the other two species of the genus; the nymphs have been observed in short-grass lawns. Moreover, individuals are distributed more sparsely than is the case with the former two species, being found ranging from very open sandy plains to finely grassed areas: thus less localised than the other species of

the genus. Adults also bask in the sun, but scarcely burrow into the sand, only the legs and ventral body parts being covered.

The writer's observations on the "digging-in" activities of *Acrotylus* species agree with the findings of Uvarov and Volkonsky on a desert grasshopper in the Northern Sahara (⁴ Uvarov and Volkonsky, 1939).

The habits of *Acrotylus hottentotus* are similar to those of the species observed by them; it prefers places covered by sand, very often windblown, and moves in short, zigzag flights. This is followed by "digging-in": the insect stands on the 1st 2 pairs of legs and throws the sands backwards with the hindlegs until a hollow is formed. At this stage the males lie down and using the elongated 2nd pair of legs cover themselves until only the dorsal parts are visible; the females however continue covering themselves until only the vertex, eyes and antennæ are visible. In the case of *Acrotylus patruelis* the "digging-in" is less complete as the whole upper part of the head, pronotum and wings are visible, while in the case of *Acrotylus angulatus* the process is still less complete, only the legs and ventral body parts being covered by sand.

4. *Trilophidia angustipennis*: This species has only been observed in the northern Transvaal; in the localities in Potgietersrust district where specimens have been caught, the species forms only a sparse population. The colour variations are found on the same type of reddish soil; because of the sparse population it is difficult to judge whether the individuals of any colour variety also form a localised group. The soil preferred by this species seems to be more finely textured than that of the former species and thus *Trilophidia* is not found in the general habitat of *Acrotylus*.

On the other hand it is also generally found on soil quite bare of vegetation.

5. *Aeolopus thalassinus*: Observed over the whole northern and central Transvaal, this species is generally found in shortgrass plains, under fairly dry conditions and it is abundant in the summer. The nymphs have mostly been observed in thick sodgrass while the adults are more abundant on grazed areas.

The two colour varieties are found mixed in the natural habitat, the brown variety being much more common than the green variety; individuals of the green variety are more common in spring and early summer, while scarcely any have been observed in autumn. Being a good flier this species is more widely distributed in its natural habitat than the other species, and individuals are generally found evenly spread over grassy areas.

6. *Oedaleus carvalhoi*: Has been found ranging from the Pretoria district up to the northern Transvaal. This species has a natural

habitat varying from short to tall grass and is fairly abundant in certain areas such as grass plains.

The nymphs have also been observed in areas thickly covered with sodgrass. The two colour varieties have been found mixed in their habitat, throughout the year, although green males are always scarce. Individuals are also found well distributed over the localities in which specimens have been caught.

7. *Oedaleus nigrofasciatus*: Found in the same localities as the former species, although, being better fliers, individuals are more plentiful in areas with longer, ungrazed grass. Not as plentiful as *O. carvalhoi*, this species has, however, been observed to form a fairly dense population in its locality during certain years, as for example 1934.

During this year three species, *Oedaleus carvalhoi*, *nigrofasciatus* and *citrinus* were fairly abundant in the same localities in the Potgietersrust district.

B. Gregariousness:

In no case has any phenomenon of swarming been observed, although a pseudo-gregariousness may be the state of *Acrotylus* spp., due to their weak rate of distribution; this weak rate of distribution may be due to the fact that these species, especially *A. patruelis* and *hottentotus*, are weak erratic fliers.

IV. CHROMOSOME CHARACTERISTICS.

In the cytological work the usual technique for Orthoptera was followed, viz. fixing in Bouin's Solution and staining with Iron-Haema Foxylin. The stages in which specimens were sectioned varied from the last nymphal stage to immediately after the last moult.

A. Chromosome number:

All the species possess the number typical for the Acrididae, viz. 23 chromosomes in the diploid spermatogonia and 11 or 12 in the haploid gametes.

Not a single unquestionable exception was found in upwards of 100 specimens examined cytologically, and this further demonstrates the remarkable uniformity exhibited amongst the Acrididae with regard to chromosome numbers (⁵ McClung, 1914).

B. Chromosome morphology:

1. Form:

This has been determined throughout the stages of meiosis.

a) Spermatogonia: All species, with one exception, have the typical rodshaped chromosomes, with terminal spindle attachment.

The exception is *Oedaleus nigrofasciatus* in which 8 of the 23 spermatogonial chromosomes have submedian spindle attachments, thus showing polar views of metaphase plates with 8 J-shaped chromosomes.

b) Spermatocytes: The form of the chromosomes in the primary spermatocytes will be discussed in relation with chiasma formation. In the secondary spermatocytes the chromosomes are also rodshaped in all species excepting in *Oedaleus nigrofasciatus*, which has 4 chromosomes with submedian spindle attachments.

2. Size:

a) Spermatogonia: The spermatogonial complexes show different sizes of chromosome pairs, falling into several size classes.

Apparent differences, even in the same individual, may be due to certain causes which will be mentioned later.

b) Spermatocytes: The secondary spermatocyte metaphase shows comparable differences between chromosome sizes in a complex, although in this stage the relations are apparently different to those in the spermatogonial stage due to specific meiotic rates of contraction — thus smaller differences between the size classes.

3. Measurement of chromosome size:

The accurate measurement of chromosome lengths for purposes of comparison between species and between individuals of a species, is a difficult problem. Although an opisometric system of measuring camera lucida plate was evolved to facilitate measurement of chromosomal curvature, the following factors all co-operate in yielding results which are approximately:

a) Variations due to differences in the stage of metaphase contraction attained by the various chromosomes at the time of fixation.

b) Variations between different individuals of the same species, due to different degrees of contraction caused by the differential action of fixatives.

c) Differences of chromosome posture in the equatorial plate. Thus while the majority of rodshaped spermatogonial chromosomes lie at right angles to the spindle axis, others may be oblique or curved.

d) Variations due to genotypic control of chromosome length: length being a function of contraction of the chromatin thread and contraction being determined by one or more genes.

e) Perhaps variations due to the age of the dividing region of the testis; late stages in spermatogonial division in fairly mature testes seem to have relatively smaller metaphase complexes.

4. Comparison of chromosome sizes:

Two systems have been worked out for comparing the chromo-

some lengths of individuals of the same species, both as regards the metaphase plates of the spermatogonia and the secondary spermatocytes:

Firstly, a method based on the comparison of each chromosome length with the longest of the complex. *Secondly*, a method based on the comparison of each chromosome length with the average length of the complex. The first method has been used, because although the two methods yield comparable results, yet the range of class limits is increased by using the second method and thus the magnitude of mistakes made in drawing and measuring is increased. In this way all the chromosomes of the spermatogonial metaphase were arranged in size-classes.

In the best metaphase plates examined the number of size-classes seems to coincide with the number of chromosome pairs; however the differences in lengths of the different pairs are not proportional and thus arbitrary limits were taken to allow the lengths to fall into *four* classes, the range of each class being one-quarter of the difference in length between the longer of the longest pair and the longer of the shortest pair of chromosomes. Only the best and most horizontal metaphase plates were measured and as such plates are rare, the best secondary spermatocyte metaphase plates were also measured, as a control. This latter measurement however seems less reliable as the secondary spermatocyte division is more rapid and the chromosomes very often are prematurely divided, thus making exact measurement difficult.

In addition the chromosomes of the secondary metaphase plate seem to have a differential rate of contraction, whereby the diameter of all the contracted chromosomes is a constant, so that smaller chromosomes may contract relatively less; due to the greater contraction of spermatocyte chromosomes the proportions between the members of the complex thus seem different to what they are in the spermatogonial complex. To control any conclusions on chromosome length the primary spermatocyte metaphase was also examined, but here due to chiasma formation and the different configurations and positions in the spindle, the computation of lengths was of no value; the approximate areas exposed by the bivalents were determined by means of transparent graph paper. On figs. 138—144 are given the graphical representations of the results, for each of the 7 species, of the measurement of chromosome length in the spermatogonial metaphase plates.

The secondary spermatocytes were measured in a similar way and the lengths also calculated as percentages of the longest chromosome. In this case, although plates with polar view were plentiful, good plates with horizontal chromosomes were few, due to premature division and rapidity of movement.

Only the few with the most horizontal chromosomes were thus measured.

The data obtained was now arranged so that the chromosomes of a complex were divided up into a number of classes regarding length and the following notations may be made on this:

I) Although the number of classes of chromosome-length may be different for the different species, the arbitrary number of 4 was taken.

II) The range of each class was made one-quarter of the difference in length between the longest pair of chromosomes and the shortest pair.

III) As the lengths of each member of a pair of homologous chromosomes in spermatogonial plates may vary due to posture and stage of movement, the range of length of the complex was taken as the difference in length between the longest chromosome and the longer of the shortest pair.

IV) In apportioning the chromosomes to a class the members of a spermatogonial complex were paired off as far as possible as otherwise a chromosome that appears smaller than the other member of the homologous pair may fall in a different class.

Starting in this way with the shortest chromosomes, the X-chromosome can generally be located.

V) To control the method of measurement and classifying certain plates were drawn and measured twice.

In table 8 the chromosomes of the plates which have been measured are arranged according to their size into such a number of classes, i.e. large, medium large, medium and small.

The following observations may be made on the data in Table 8:

I) In certain cases the number of chromosomes in a complex is less than the typical number, due, for example, to the lack of X-chromosomes in half the secondary spermatocytes.

II) The figures for secondary spermatocytes are not as reliable as those for spermatogonia, as contraction in meiosis is differential, division very often premature (Fig. 46) and the form of the chromosome conditioned by the previous formation of chiasmata.

III) Large discrepancies in the measurements for length would appear to be due to posture in the equatorial plate, and the stage of movement, that is, pre- or post-metaphase movement.

IV) Possibly the X-chromosome also causes discrepancies in the measurement and classifying of the chromosomes of secondary spermatocytes, as it is precocious in movement during the primary spermatocyte stage and as it only divides once and thus showing a different relative contraction.

V) The J-bent chromosomes of *Oedaleus nigrofasciatus* proved difficult to measure accurately. On the other hand the chromosomes

Table 8: Chromosome size-classes in the 7 species.

Size	Spermatogonia								Secondary spermatocytes							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	
<i>Acrotylus patruelis.</i>																
Large	4	4	4	4					3	2	2					
Medium large	5	3	5	5					1	2	3					
Medium	8	10	8	8					4	4	4					
Small	6	6	6	6					3	3	3					
<i>Acrotylus hottentotus.</i>																
Large	4	4	4						1	2	2					
Medium large	5	7	7						2	4	2					
Medium	8	6	6						5	2	4					
Small	6	6	6						3	3	3					
<i>Acrotylus angulatus.</i>																
Large	4	4	2	4					2	2	2	3	2	3		
Medium large	5	7	5	7					3	4	2	2	3	2		
Medium	8	6	8	6					4	3	4	4	3	3		
Small	6	6	8	6					2	3	3	3	3	3		
<i>Trilophidia angustipennis.</i>																
Large	4	4	4	4	4	4	4	4	2	2	1	3	2			
Medium large	5	5	7	5	5	7	5	5	3	3	4	2	2			
Medium	10	10	6	8	10	8	10	10	5	5	5	4	5			
Small	4	4	6	6	4	4	4	4	2	2	2	3	2			
<i>Aeolopus thalassinus.</i>																
Large	4	4	4	4	5	4	4	4	2	2	2	2	2	3		
Medium large	5	5	7	7	6	5	5	5	4	3	2	2	4	2		
Medium	8	8	6	6	6	8	8	8	3	4	4	4	3	3		
Small	6	6	6	6	6	6	6	6	3	3	3	3	3	3		
<i>Oedaleus carvalhoi.</i>																
Large	4	4	5	5	5	5	5		2	3	3	3	2	3	2	
Medium large	3	5	6	6	6	6	6		3	2	5	4	2	3	3	
Medium	12	10	8	8	6	8	8		4	4	2	3	5	4	4	
Small	4	4	4	4	6	4	4		3	3	2	2	2	2	3	
<i>Oedaleus nigrofasciatus.</i>																
Large	4	4	5	4	4				2	2	2	3	3	2		
Medium large	4	6	4	5	5				3	2	3	3	2	2		
Medium	8	6	8	8	8				3	4	4	2	4	4		
Small	6	6	6	6	6				4	3	3	3	2	3		

of these complexes were more easily paired off in classifying according to length and thus served as a control on what to expect in the other species, as regards apparent differences in length between members of a pair of homologous chromosomes.

VI) The data obtained for primary spermatocytes as regards area exposed in polar views of metaphase, more or less support the data obtained for chromosome length in spermatogonia and primary spermatocytes. The smaller-sized chromosome-classes, often contain a larger proportion of chromosomes as compared with the other divisions due to the fact that some of the medium-sized bivalents pairing end-to-end at metaphase, are seen endwise in polar views and thus appear small.

VII) In certain cases pairing off homologous chromosomes in spermatogonial plates is rendered difficult by large variations between what appears as a pair. Thus in *Oedaleus carvalhoi* in spermatogonia Nos. 3, 4, 5 and 7 in table 8 the classes "large" and "medium large" may contain either 5 and 6 chromosomes respectively, or 6 and 5; in *Trilophidia angustipennis* in spermatogonia Nos. 1, 2 and 5 in table 8 the class "large" may contain only 3 instead of 4 chromosomes.

VIII) Very often the limits of size-classes are occupied by chromosomes which differ only slightly in length, for example in *Acrotylus angulatus* in spermatogonium No. 1 in figs. 138—140 the upper limit of the class "small" is occupied by chromosome of size 31 and the lower limit of the class "medium" is occupied by chromosomes of size 31 and 32; likewise in other cases. This seems to indicate certain natural classes not defined by the arbitrary system used.

IX) On the other hand in this system used cases occur where too low length values for certain chromosomes may cause all spermatogonia measured apparently to coincide in the number of chromosomes in a class, while in reality some of the higher classes should contain more.

Such is the case in *Oedaleus carvalhoi* in figs. 143 and 144 in spermatogonia 6 and 7 where the chromosomes of sizes 37 and 36 respectively are on the lower limits of the class "medium large" and thus the pair of chromosomes headed by each may conceivably fall in that class instead of in the lower class; that this is a possibility seems indicated by certain of the secondary spermatocytes.

5. Comparison of chromosome length between species:

The only method of comparison of spermatogonial chromosome lengths between species that has been attempted is a graphical method (cf. figs. 138—144). Because of the difficulties already mentioned the secondary spermatocyte chromosomes have not been compared between the different species.

6. Conclusions on chromosome size:

I) Notwithstanding the arbitrary limits set and the arbitrary system of measurement followed, the preceding tables yield some

comparable results. Table 9 gives the results of firstly, the classes of chromosome size actually obtained from the data of table 8 and secondly, the most probable classes, obtained when the data and the graphical representation are inspected and the discrepancies mentioned are kept in mind.

Table 9: Chromosome size-classes in the 7 species.

Size-class	Acro- tylus patru- elis	Acro- tylus hotten- totus	Acro- tylus angu- latus	Trilo- phidia angusti- pennis	Aeolo- pus thalas- sinus	Oeda- leus carval- hoi	Oeda- leus ni- grofas- ciatus	
From Table 8								
Large	4	4	4	5	4	5	4	
Medium large	5	7	7	5	5	6	5	
Medium	8	6	6	10	8	8	8	
Small	6	6	6	4	6	4	6	
Probable								
Large	4	4	4	5	4	5	6	4
Intermediate	13	13	13	14	13	14	OR 13	13
Small	6	6	6	4	6	4	4	6

II) These figures and the graphical representation show that the range of variation is more or less similar in all the species; thus proving the constancy of chromosome morphology and perhaps the close phylogenetic relationship amongst this group. Even in *Oedaleus nigrofasciatus*, with submedian or subterminal spindle attachments in 4 pairs of chromosomes, more or less the same range of variation in size is found as in the other species.

III) On the other hand small, but definite, variations are found, such as the fact that the variation in size of the chromosomes in *Acrotylus patruelis* and *A. hottentotus* are more continuous than is the case in the other species, that in *Trilophidia angustipennis*, *Aeolopus thalassinus* and *Oedaleus nigrofasciatus* the class of "small" chromosomes is more clearly separated from the other classes and that in *Trilophidia angustipennis* there is a greater concentration of chromosomes round the mean than is the case with the other species.

IV) There seems no closer resemblance between the complexes of the species of a genus than between those of species of different

genera, with the exception of *Oedalcus nigrofasciatus*. The external morphology of *Acrotylus patruelis* and *A. hottentotus* is superficially greatly similar but differs markedly from that of *Acrotylus angulatus*; yet the chromosome complexes of the 3 species do not differ so definitely, as regards length.

V) The constancy of the X-chromosome seems proved; its location in the large or medium large class seems evident from an inspection of the paired lengths in the data.

C. Chiasma formation in meiosis:

Chiasmata formed by crossingover in the pachytene stage cause a variety of forms in subsequent phases of the bivalents in all 7 species.

1. *Forms of the primary spermatocyte metaphase bivalents:*

The forms found in all species at metaphase are rings, V's, rods and crosses.

a) Rings: Comparison of the diplotene and diakinesis stages of prophase with the metaphase show no appreciable reduction in the number of chiasmata in most bivalents. However in some of the bivalents reduction in number does seem to take place. In all cases of rings, terminalisation, if it occurs, is never found in the proximal chiasma, so that the fusion of chiasmata takes place only at the distal ends of bivalents.

Rings are thus apparently formed in the following ways:

Firstly, where reduction of 4 or 3 chiasmata to 2 takes place in the metaphase, then the ring lies in the equatorial plate, is closed distally and has two diverging arms between the spindle attachment and the first chiasma, and these arms are extended in the axis of the spindle (Fig. 4). This type of ring may however also represent a bivalent with 2 chiasmata, one localised near the spindle attachment and the other an interstitial chiasma which has become terminalised (Fig. 2).

Secondly, where 2 chiasmata occur and where little or no movement of the distal chiasma takes place, then a ring is formed with two pairs of diverging arms; the proximal pair contains the spindle attachments and lies extended in the direction of the spindle axis, while the distal pair lies in a direction depending on the length — very often obliquely extended towards the equatorial plate, in which case the middle annular part of the bivalent is shifted slightly out of the equatorial plate (Fig. 5).

This type of ring cannot have contained more than 2 chiasmata as at metaphase all chiasmata above the number of 2 must then by shifting away from the spindle attachment, have been broken at the distal ends of the bivalents, a fact which has not been proved (Darlington, 1932).

Thirdly, bivalents with 3 chiasmata may have originated with only 3 or may be the result of a reduction from 5 or 4 to 3.

In such cases a double ring is formed with two diverging arms proximal to the first chiasma and lying in the direction of the spindle axis, then a ring in the equatorial plate, followed by a smaller ring bent more or less at right angles to the first ring, that is extended in the direction of the spindle axis (Fig. 8).

b) V's: These are bivalents extended in the equatorial plate with a single chiasma localised near the spindle attachment, and showing no appreciable movement of this chiasma between diplotene and metaphase (Fig. 7).

c) Rods: These are generally the smaller bivalents, showing a cross formation in the diplotene but with the single chiasma totally terminalised at full metaphase. Thus the crosses found appear doubtful and may be earlier stages of the final metaphase rods (Figs. 9, 10).

2. Chiasma frequencies at metaphase in the 7 species:

At metaphase, in all species, rods and V's are most common and these can be taken to represent 1 chiasma each. Rings of the first type are common, but may represent 2 or more chiasmata formed at pachytene, while rings of the second type, also common, are taken to represent 2 chiasmata formed at pachytene. Rings of the third type are relatively scarce and in some species they have not definitely been located. Table 10 gives the results obtained in the 7 species, from the inspection of chiasma frequencies in a large number of plates.

The frequencies of chiasmata most common per bivalent at metaphase are 2 and 1; each complex has been divided into two groups, i.e. bivalents containing two and bivalents containing one chiasmata. Due to the fact that the third type of ring, i.e. the double ring, is relatively scarce and more-over is difficult to recognise conclusively, this type representing 3 visible chiasmata at metaphase, has been included with the class of bivalents containing 2 visible chiasmata.

Observations to be made on this table are:

I) All the plates examined and counted were polar views. In side views V's and many rings are indistinguishable.

II) In some cases the plates examined were at the beginning of anaphase and then rings and V's which are being disjointed appear very similar, i.e. seemingly rounded figures with two diverging arms proximally, may in reality be V's with 1 chiasma instead of rings with 2 chiasmata — this would be due to the fact that the distal parts are then close together, in anaphase movement. This fact naturally causes certain discrepancies in the results obtained.

III) From the data it may be seen that the chiasma frequency in any species is not a constant and thus chiasma frequency is not

Table 10: Frequencies of chiasmata at first metaphase.

Bivalents per plate		Number of plates examined						
Number of bivalents with 2 chiasmata	Number of bivalents with 1 chiasma	<i>Acrotylus patruelis</i>	<i>Acrotylus hottentotus</i>	<i>Acrotylus angulatus</i>	<i>Trilophidia angustipennis</i>	<i>Aeolopus thalassinus</i>	<i>Oeda-leus carval-hoi</i>	<i>Oeda-leus nigrofasciatus</i>
1	10				4			
2	9			5	25			
3	8	1		14	23	8	6	4
4	7	5	1	19	11	9	24	12
5	6	10	4	5	6	7	26	7
6	5	2	8	1	1	2	7	
7	4	2	1	1	1	1	1	
Totals of plates		20	14	45	71	27	64	23

directly proportional to the length of the conjugating chromosomes; chiasma frequency is thus liable to natural variation.

IV) On the other hand each species seems to have a modal number as regards chiasma frequency, more or less specific to it. This modal number is not conditioned by the average length of the chromosome complex; this fact is evident in comparing, for example, *Acrotylus patruelis* and *Acrotylus angulatus*.

V) The largest percentage of variation is found in *Aeolopus thalassinus*. This fact may however be due to the relatively small number of plates examined and conceivably a more rapid rate of disjunction, so that the factor mentioned in point II) comes into play.

VI) Plates with 7 bivalents having 2 chiasmata and only 4 bivalents with 1 chiasma have been noted. In these cases, however, the bivalents are drawn more closely together so that this is probably the start of anaphase - the results thus also show the effect produced by the factor mentioned in point (II).

VII) In general, therefore, the chiasma frequencies as indicated by the modal numbers, seem fairly representative for each species.

VIII) Bivalents with 3 chiasmata, i.e. in the form of a double ring, are rare and may be mistaken for rings of the second type, in which the two distal diverging arms are swinging about in anaphase movement.

They can however be fairly evidently located in certain species. In *Acrotylus patruelis* about one-quarter of the plates examined seems to have one bivalent with 3 chiasmata (Fig. 5); similarly *Acrotylus hottentotus* (Fig. 27). In *Acrotylus angulatus* the percen-

tage is smaller and in *Trilophidia angustipennis* such bivalents are very rare, as also in *Aeolopus thalassinus*. In *Oedaleus carvalhoi* the percentage of occurrence is probably higher (Fig. 88) while in *Oedaleus nigrofasciatus* this type of figure has not been observed.

IX) In *Oedaleus nigrofasciatus* another possibility, however, occurs. Some of the chromosomes which are J-shaped, due to submedian spindle attachment, may in a certain number of cases produce a chiasma in the short arm. This chiasma would then become terminalised and is not very evident in polar views. Taken in conjunction with side views however, this chiasma does seem to be formed (Figs. 106, 112). Whether in such cases the longer legs of the bivalent produce 3 chiasmata, has in no instance been definitely observed, so that in bivalents of this type the occurrence of only 3 chiasmata can be concluded.

3. Types of Chiasmata:

The longer bivalents all have at least one chiasma near the spindle attachment at metaphase and this proximal chiasma is also found at diplotene and diakinesis and is thus localised. Most of the longer bivalents have in addition another chiasma which is distal, either interstitial or terminal and which is thus a chiasma formed at random or distributed. As mentioned, bivalents with a proximal localised chiasma and 2 distal chiasmata of which the most distal one is terminalised are rare. Some of the shorter bivalents may also have one localised chiasma and one distal terminalised chiasma.

In general, however, the shorter bivalents have either a localised chiasma which seems to produce the V-figure or a distributed or localised chiasma which becomes terminalized to produce the rod-figure.

4. Chiasma types at metaphase in the 7 species:

Definite variations appear between the species as regards the configurations most common among the bivalents at first meiotic metaphase. From the consideration of a large number of figures, the results are given in table 11 of the following types of configurations:

Firstly, the different types of rings, all constituted of at least two chiasmata: the type of ring depending on whether terminalisation has taken place or not. These are generally the large and large medium chromosomes. *Secondly*, the V's which are bivalents with one localised chiasma at metaphase. *Thirdly*, the rods which are bivalents with one distributed or localized chiasma, which becomes terminalised at metaphase.

Observations to be made on this table are:

1) The data was obtained from the examination of sections of ap-

Table 11: Types of chiasmata at first metaphase.

Bivalents per plate			Number of plates examined						
Rings	V's	Rods	Acro- tylus patruel- lis	Acro- tylus hottotus	Acro- tylus angulatus	Trilo- phidia angusti- pennis	Aeolo- pus thalas- sinus	Oeda- leus carval- hoi	Oeda- leus nigrofas- ciatus
7	2	2						1	
7	1	3	1		1	1			
7	0	4	1	1			1		
6	4	1							
6	3	2			1			3	
6	2	3	1	4		1	1	4	
6	1	4	1	4			1		
6	0	5							
5	5	1							
5	4	2						4	
5	3	3						12	3
5	2	4	2	3	2	5	3	9	4
5	1	5	8	1	3	1	4	1	
5	0	6							
4	6	1							
4	5	2						3	
4	4	3			3			5	1
4	3	4			7	5		12	10
4	2	5	3	1	7	2	8	4	1
4	1	6	2		2	3	1		
4	0	7							
3	7	1							
3	6	2							
3	5	3			2			1	
3	4	4			5	6	4	2	1
3	3	5			4	11	2	2	1
3	2	6	1		3	6	2	1	2
3	1	7							
3	0	8							
2	6	3							
2	5	4			3	7			
2	4	5			2	8			
2	3	6				8			
2	2	7				2			
2	1	8							
2	0	9							
1	7	3							
1	6	4				2			
1	5	5				2			
Totals of plates			20	14	45	71	27	64	23

proximately 60 individuals with a minimum of 4 individuals yielding good results per species.

II) From the data it may be seen that the types of chiasmata in any species is not a constant and thus type of configuration is not directly specific, but is liable to a natural variation.

III) On the other hand each species seems to have a modal type as regards the configurations in a complex. As for chiasma frequency, this type is not conditioned by the average length of the chromosome complex (cf. for example the many long V's in the plates for *Trilophidia angustipennis*).

IV) In some cases modes appear, in a species, for different classes of configuration types. For example in *Acrotylus angulatus* 7 plates with four rings had 3 V's, while 7 plates, also with four rings, had 2 V's. In some of the cases at least these results may be due to the fact that anaphase movement has already started and thus smaller V's are drawn out to resemble rods.

V) Possibly some of the bivalents with a single chiasma may never terminalise the single chiasma before full metaphase and would thus in a way resemble V's. Although some of these bivalents, especially in oblique sections, may be mistaken for V's, yet they would not have the actual value of a V as the relations between spindle attachment and equatorial plate would be different. This type of chiasma may have caused misrepresentations in the results of table 11.

5. Observations on the diplotene and diakinesis stages:

The frequencies and types of chiasmata in both the diplotene and diakinesis stages were observed.

a) *Acrotylus patruclis*:

I) Rings: In diplotene, rings of the second type, with two chiasmata, are mostly found (Fig. 1). In diakinesis the two pairs of diverging arms of these rings appear shorter and a fair percentage have the distal diverging arms terminalised. Rings of the third type, with 3 chiasmata, are fairly common in diplotene (Fig. 3). In some cysts on the average one-half of the plates have a ring of this type and in a single case two of these rings have been observed in one nucleus during diplotene. These double rings have also been observed in diakinesis, with neither of the two pairs of diverging arms terminalised. In no single instance has a bivalent with 4 or more chiasmata been observed in either the diplotene or the diakinesis stage.

II) V's: These configurations, with more extended arms, are found in the two stages, but are not very common.

III) Rods: Crosses (Fig. 22) are found in late diplotene, but are not so common in diakinesis, when bodies which are more rod-like (Fig. 10) seem to replace them.

b) *Acrotylus hottentotus*:

I. Rings: Rings of the second type are common in diplotene and diakinesis, but in diakinesis there is less terminalisation of the distal chiasma than in the former species. Rings of the third type, with 3 chiasmata, are fairly common in the two stages.

In one cyst nearly every nucleus had apparently one bivalent with 3 chiasmata, the most distal chiasma often being already terminalised in middle diplotene.

Several nuclei were observed to contain two bivalents with 3 chiasmata each — thus more prevalent than in the former species. In a single instance a bivalent was observed in late diplotene with 4 chiasmata.

II) V's: These configurations are not very common, unless certain figures which are apparently crosses, are the earlier stages (Fig. 33.)

III) Rods: Crosses are found in both the stages, although in diakinesis one pair of arms is much shortened (Figs. 32 and 34). Bodies which are presumed to be rods are found in diplotene, but are more common in diakinesis.

c) *Acrotylus angulatus*:

I) Rings: Rings of the second type are fairly common in diplotene and diakinesis, while rings of the first type are found only in diakinesis. Few rings of the third type, i.e. with 3 chiasmata, were observed; in several cysts however about one-quarter of the nuclei have a bivalent with three chiasmata.

Bivalents with 4 chiasmata were never definitely observed.

II) V's: These configurations are more of the nature of crosses in diplotene, but appear definitely as V's in diakinesis, in which stage several fairly large V's are prevalent.

III) Rods: Small crosses are prevalent throughout diplotene and the start of diakinesis, when small rods become more prevalent. In diakinesis crosses are still found but are more rodlike in structure (Fig. 10).

d) *Trilophidia angustipennis*:

I) Rings: Rings are common in both stages and all three types are found. In the earlier stages rings of the second type are more common, but very often the central loop is small and flattened. Rings of the first type, i.e. with two chiasmata and having the second or distal chiasma terminalised, are observed from middle diplotene onwards. Rings with 3 chiasmata were observed in both stages. Only one instance of an apparent four-chiasma bivalent was observed.

II) V's: These configurations, of varying sizes, are found from late diplotene onwards.

III) Rods: Small crosses are found from diplotene onwards, while small rods become prevalent from early diakinesis. Larger crosses, with two very short arms, are found from diplotene onwards and as for the former species these crosses are more rodlike (Fig. 62, 64).

e) *Aeolopus thalassinus*:

I) Rings: Rings of the second type are common in both stages both rings with the distal chiasma terminalised are found only from very late diplotene onwards. Rings with 3 chiasmata are not very common in any of the stages and a bivalent with 4 chiasmata was observed only once.

II) V's: These configurations only become apparent from late diplotene onwards.

III) Rods: Small crosses are common in diplotene, but seem to be replaced by small rods from late diplotene onwards (Fig. 79). In some cases small crosses are still found in diakinesis together with larger crosses, which have a pair of very short arms. From diplotene onwards some of the rods are often very small and rounded. In this species terminalisation often shows an attenuation of the contact between the pair of the bivalent, due to spindle attachment repulsion (Fig. 80).

f) *Oedaleus carvalhoi*:

I) Rings: Rings of the second type, with two unterminalised chiasmata, are fairly common in both stages; this species differs from the preceding five however, in the fact that the central loop of rings is very often still flattened in diplotene and diakinesis. Rings with the distal chiasma terminalised were hardly ever observed in either diplotene or diakinesis. Rings with 3 chiasmata are fairly common in both stages and in one instance two were observed in one nucleus. No definite instance of 4 or more chiasmata in one bivalent has been observed.

II) V's: These configurations are only definite in the later stages.

III) Rods: Small crosses are prevalent in late diplotene, but no definite rodlike configurations have been observed in either diplotene or diakinesis. Very often all bivalents in both stages appear very rodlike.

g) *Oedaleus nigrofasciatus*:

I) Rings: Rings of the second type, with two unterminalised chiasmata are common in both stages, but very often have the loop still very much flattened in diplotene. Terminalization of the distal chiasma is rare in any of the stages. Because of the small amount of

distension of loops, rings with 3 chiasmata are difficult to recognize but do occur and with one chiasma terminalized, either the proximal or the distal.

II) V's: These configurations occur in both stages, but with the long arms only slightly extended.

III) Rods: Small crosses appear in diplotene but, together with rods, are difficult to recognise in diakinesis. All chromosomes in this species are in a more diffuse state during diplotene and diakinesis than is the case with the other species.

6. Conclusions on chiasma formation in the 7 species:

A general survey of all configurations of bivalents in the stages of prophase and metaphase has led to the following conclusions:

a) The occurrence of localisation of chiasmata, i.e. the formation of chiasmata near the spindle attachment, is an established fact in all species.

Two types of localisation are found: *Firstly*, the bivalents with a V-configuration. *Secondly*, the proximal chiasma in the ring configurations may also be concluded to be localised, due to the fact that its distance from the spindle attachment remains more or less constant and also that, when in such a bivalent, the second chiasma, which may be at random, is not formed, the configuration becomes a V (cf. figures of *Trilophidia angustipennis*).

Localization of chiasmata may be due to polarization or the formation of a bouquet stage at leptotene; this regular arrangement in more or less parallel threads has been observed in certain cases, although in general this stage is not clear due to the material not having been specifically stained for it. Precocious condensation of the distal parts of the conjugating chromosomes as a cause of localisation has not been conclusively proved.

Taking into consideration the fact, as has been mentioned, that many of the first metaphase plates cannot be taken as unquestionably showing the constitution of chiasmata, then the great majority of the best and most level plates in tables 10 and 11 yield the following results as regards the types of chiasmata: rings are also, as regards the proximal chiasma, taken to represent localisation at metaphase.

To this generalisation there are, however, variations which are valid and which will still be discussed.

b) The study of the movement of chiasmata explains certain problems regarding localisation of chiasmata.

I) In the first instance localised chiasmata, the case both of single chiasmata and where the rest are distributed, do not seem to move greatly during the advance of prophase. A comparison of all the stages has forced the conclusion that if there is movement it cannot be detected.

Table 12: Localisation of first metaphase complexes:

Species	Bivalents in a complex	
	With localised & semi-localised chiasmata	With terminalised chiasmata
<i>Acrotylus patruels</i>	6	5
<i>Acrotylus hottentotus</i>	7	4
<i>Acrotylus angulatus</i>	7	4
<i>Trilophidia angustipennis</i>	7 or 6	4 or 5
<i>Aeolopus thalassinus</i>	7 or 6	4 or 5
<i>Oedaleus carvalhoi</i>	8	3
<i>Oedaleus nigrofasciatus</i>	7	4

II) Non-movement of localised chiasmata may be due to the fact that, as movement has to take place from the spindle towards the distal parts, the power of repulsion between the shorter arms of the bivalent is too weak to overcome the power of repulsion between the longer distal arms, with the result that the chiasma remains constant in position.

III) Localisation seems obligatory in all the species, with the result that in *medium-sized* chromosomes the configuration becomes a V or a rodlike form lying extended in the equatorial plate, but with two small diverging arms, lying extended in the direction of the spindle axis (Fig. 31). In the *larger* bivalents one or two, rarely more, chiasmata may then be formed distally at random, to give the configuration of a ring. In the *smaller* bivalents the single chiasma is also localised, but it is suggested that due to the shorter length of the distal arms the repulsion between them cannot overcome, but is itself overcome by, the combined repulsions between the proximal arms and the spindle attachments. The result therefore is terminalisation to produce rodlike bivalents.

IV) This suggests that, although the single chiasma found in the smaller chromosomes seems to be at random because it becomes terminalised at metaphase and because it seems central in position during diplotene and sometimes during diakinesis, the fact is that even with localisation the chiasma cannot be relatively as far from the distal ends of the pairing chromosomes as in the larger bivalents.

V) This formation of a cross during diplotene and sometimes during diakinesis, taken in conjunction with the numbers of bivalents with terminalized chiasmata in all species and the especially large variations in some species, leads to the supposition that in any bivalent a localised chiasma is not necessarily formed at a certain

constant point in the chromosome length, but varies slightly in position. The result would be that in the shorter chromosomes, when this point of crossing-over is situated at such a distance from the spindle attachment that the combined repulsions of the spindle attachments and the proximal arms cannot overcome the repulsion between the distal arms, then no movement takes place and the result is a V-configuration instead of a rod. In a like manner when the point of crossing-over is still nearer the spindle attachments, then the repulsion between the distal arms would be in excess to such an extent that they are much extended and what seems to be a rod lying extended in the equatorial plate is formed. On the other hand when the point of crossing-over is nearer equilibrium, movement would only be slight and partial terminalisation takes place at metaphase (Figs. 10, 89).

The percentage of terminalisation then seems to depend mainly on 2 factors:

Firstly, the number of small chromosomes in a complex (cf. the differences between the 7 species). *Secondly*, the point of crossing-over in such smaller chromosomes. The figures given in Table 12 are thus to be taken as giving the average incidence of total terminalisation in each species.

VI) In a similar way the fate of the type of ring configuration formed, seems to be solved. If the distal chiasma, which is formed at random, is sufficiently near to the proximal or localised chiasma, then the repulsion between the penultimate arms, i.e. the loop, is not sufficient to overcome the repulsion between the ultimate arms and thus no movement or only at a slight rate takes place and the result is a ring of the second type at metaphase (Fig. 5). On the other hand if the distal chiasma is further away the repulsion between the arms of the loop may cause movement and the distal, random chiasma is terminalised, forming a ring of the first type at metaphase (Fig. 2).

The proportions of each of these rings would then show the varying ranges of distributed crossing-over in each of the species.

Table 13 gives the most general recurring types of distributed chiasmata at first metaphase in each of the species; bivalents with 2 distal distributed chiasmata are included with the class of bivalents having 1 distal distributed chiasma at metaphase, because in such instances the most proximal distributed chiasma is similar in location.

To this average there are however variations, depending on the situation of the point of crossing-over, the specificity of the rate of movement and the number of what are ordinarily V's which attain a second chiasma. For example, in *Trilophidia angustipennis* in a number of instances 5 rings have been observed in diakinesis and metaphase and in *Oedaleus carvalhoi* in a few instances 6 rings have

Table 13: Distributed chiasmata in first metaphase complexes:

Species	Ring bivalents per complex	
	With distal chiasma distributed	With distal chiasma terminalised
<i>Acrotylus patruelis</i>	3	2
<i>Acrotylus hottentotus</i>	4	2
<i>Acrotylus angulatus</i>	3 or 2	1 or 2
<i>Trilophidius angustipennis</i>	2	1 or 0
<i>Aeolopus thalassinus</i>	3	1 or 0
<i>Oedaleus carvalhoi</i>	3	2 or 1
<i>Oedaleus nigrofasciatus</i>	3	1

been observed. In general, as regards specificity of movement the two species *Oedaleus carvalhoi* and *O. nigrofasciatus* are perhaps less rapid in the movement of terminalising chiasmata.

VII) In the longest pair of chromosomes, as mentioned, two distributed chiasmata may sometimes be formed distally. In this case therefore the most distal chiasma would most likely be terminalised at metaphase and the resultant configuration would be a ring of the third type (Fig. 8).

Contrary to what was stated above in explanation of the forms of bivalents at first metaphase, the rings of the first type would then only represent 2 chiasmata, unless both distal chiasmata were situated so much towards the end that the movement of the penultimate loop caused the terminalisation of both, which might not be a very probable occurrence.

Taken in conjunction with the stages of prophase, an examination of metaphase plates shows the different species to have the following characteristics as regards the formation of bivalents with 3 chiasmata at metaphase: *Acrotylus hottentotus* seems to form the most, perhaps one-third of the plates examined possessing one bivalent with 3 chiasmata. In *Acrotylus patruelis* the occurrence of these bivalents is slightly less and a further decrease is found in *Acrotylus angulatus* and *Oedaleus carvalhoi*. There is a further decrease in occurrences in *Trilophidia angustipennis* while the number of these chiasmata in *Aeolopus thalassinus* is negligible. In *Oedaleus nigrofasciatus* another type of phenomenon occurs.

VIII) In *Oedaleus nigrofasciatus* crossing-over is comparable to crossing-over in *Oedaleus carvalhoi*, although it has, exceptionally, 4 pairs of chromosomes with submedian spindle attachments.

Of these 4 pairs two pairs are in addition the largest pairs in

the complex, the other two pairs falling in the large medium class (perhaps 1 pair in the medium class). Only one pair, the longest, have the short leg of the J of any considerable length. Thus in most instances the localised chiasma cannot be formed proximally to the spindle attachment, but is formed distally, i.e. on the long leg. The resultant configurations at first metaphase are thus generally rings for the first 3 pairs of J-shaped chromosomes and a ring or a V for the 4th or shortest pair. If the localised chiasma were regularly to be formed on the short leg, then more rings would be formed lying extended in the direction of the spindle axis, instead of perpendicular to it: the reason being that parts which generally lie perpendicular to it would then swing in its direction.

The inspection of both polar and equatorial views at metaphase shows that in a few cases a chiasma is formed on the short leg of the largest J-shaped pair of chromosomes and that this chiasma becomes terminalised at metaphase. (Figs. 106, 112, 114). Generally these shorter legs are without a chiasma (Figs. 107, 109, 113). This species then has an exceptional chromosome complex which does not seem to have originated from changes due to fusion or translocation amongst the chromosomes, but possibly from changes due to the shifting of the spindle attachment to a point near the general location of the localized chiasma.

c) Certain conclusions arise out of the study of the frequency of crossing-over:

I) As the average frequency of chiasmata is generally recognised as being proportional to the length of the chromosomes paired at pachytene, the fact that many bivalents form large V's seems to indicate that pairing takes place only along a certain length of the pair.

II) Frequency of crossing-over varies between individuals of a species but also as regards the general type of a species. That this fact does not depend on the average length of the spermatogonial complex can be concluded by correlating the graphs in figs. 138—144, and with the tables on chiasma frequency. Species showing a low number of bivalents with more than 1 chiasma, per complex on the average, as compared with their average spermatogonial chromosome lengths, are *Acrotylus angulatus* and *Trilophidia angustipennis*. *Acrotylus hottentotus* again shows a higher proportion of bivalents with more than 1 chiasma, per complex on the average, as compared with the other species. Frequency of crossing-over thus seems to be modified by the genotype.

III) Frequency of crossing-over seems to be modified in many individuals in a species due perhaps to such factors as age, undetermined developmental factors but most likely due to the genotype of

the individual. All species show this variation between individuals but not to such an extent as in the following: One individual of *Trilophidia angustipennis* almost exclusively has plates with 2 bivalents containing 2 chiasmata each, while another individual as exclusively shows plates containing 5 bivalents with 2 chiasmata each. In *Aeolopus thalassinus* again one individual, without exception, had 3 rings in all plates examined, while the general type for the species is 4 rings. The biggest variations in crossing-over frequency between individuals in a species are in fact found in those species showing outstanding colour variations; the implications of this phenomenon have not yet been determined.

IV) In connection with this phenomenon the following data on the crossing of colour varieties in *Trilophidia angustipennis* may be noted.

In Table 14 are given the constitutions of first metaphase plates of certain individuals in these crosses.

These data suggest that crossing-over is reduced in the 1st generation of a cross between colour varieties, as well as, but to a lesser extent in later generations. Although insufficient data has as yet

Table 14: Variation in chiasma frequency in varieties of *Trilophidia angustipennis*.

Class of Plate	Number of plates in each class			
Number of bivalents per plate, having more than 1 chiasma	*) Individual No.			
	42	52	64	60
6			1	
5	3		4	
4	4	1		
3	1	1		5
2		3		10
1		1		2

*) The records of breeding of the individuals were as follows:

No. 42: A light brown variety bred from the first light brown individuals caught.

No. 52: A grey brown individual bred from a female of the same type and generation as No. 42 and a male of the grey brown variety obtained from the 1st generation of the red brown red brown breeding.

No. 64: A red brown individual obtained from the 3rd generation of the red brown x red brown breeding.

No. 60: A reddish brown individual obtained from the 1st cross of grey brown x red brown.

been obtained on all the colour variations, the results thus far obtained indicate certain possibilities:

Firstly, a genetic control of crossing-over, i.e. a control of the chromosomes by genes in the complement, causing differential rates of torsion in prophase and thus of the causative factor for crossing-over, or *Secondly*, a structural control through differences between the chromosomes as regards arrangement in the thread, etc. *Thirdly*, from the probabilities expressed arises the inference that decrease of crossing-over between the chromosomes of the different colour varieties is due to the fact that the characteristics of these varieties are in the nature of racial.

Since in breeding experiments a certain degree of dominance has been expressed in the factorial complex influencing colour, this suppression of crossing-over between the greater part of the length of the larger chromosomes may stand in relation to the fact that the races inhabit the same locality in more or less equal numbers.

V) The effect of environmental conditions on chiasma frequency has, as yet, not been fully tested; in general it may be said, in the case of *Acrotylus hottentotus*, that individuals of later generations bred in the northern Transvaal show a decrease in frequency of chiasmata, as compared with individuals of the first generation bred from specimens collected in the southern Transvaal. The paucity of good plates invalidates definite conclusions.

GENERAL CONCLUSIONS.

1. Gonad anatomy: In gonad structure great similarity is shown in both anatomical and histological characteristics, the only important variation inter-specifically being the number of follicles.

2. Physiologically no great variations have arisen in adaptiveness, mainly due to a general similarity in the ecology, food and method of oviposition of the species. Thus the assumption may be made that the only important limitation to interspecific crossing would be physiological differences dependent on the pH and chemotaxis of the secretions of the gonads.

3. As regards the chromosome complement the variations seem due to genotypic control and not to structural variations of the grosser kinds, as for example fusion or fragmentation.

The general type of mitotic and meiotic structures are similar and localised crossing-over apparently obligatory.

Thus all the species are characterised by a suppression of crossing-over, due to localisation of chiasmata during the prophase of meiosis. This suppression is most likely genetically determined or through an inherent quality in the origin of the genotype.

The differences between the seven species may then have

originated in one or more ways of segregation: *Firstly*, habitative, which seems improbable as the species are found in either the same or in overlapping areas. *Secondly*, structural, also improbable because of the intrinsic similarities and because taxonomic differences are not necessarily physiologically valid. *Thirdly*, physiological, which would be a logical type of segregation especially as regards the generative organs, although valid physiological differences have not been proved. *Fourthly*, ecological, although here even a greater similarity appears as the effects of season and climate generally are identical, due to identical or overlapping habitats. *Fifthly*, the genetic make-up, because of the certain intrinsic differences between the species, cannot be assumed to be similar to the point of complete allelomorphism between the species and thus genetic isolation would be the important type of segregation in this group, i.e. an accumulation of lethal or sterility factors.

After a consideration of all data there appears to be no *a priori* reason why interspecific crossing, either natural or artificial, should be improbable, at least in each genus. The following points may be taken as supporting this hypothesis:

1. If the differences between the species are due to a genetic control, through mutation, then the meiotic power of pairing through allelomorphism will still be active.

2. If the variations have been determined through structural changes then the region where localisation of crossing-over takes place, would seem to stand the best chance of surviving and thus this region could presumably be similar in some or all of the species, allowing normal pairing and segregation to take place in a cross between species.

3. Even if structural differences as, for example, translocation or inversion are the influencing factors, then, because of localised crossing-over, there is still no reason for intersterility.

4. Changes in the genetic make-up caused by mutations, which would influence the segregation of the species, would only be valid if there were no interference which the nicely balanced processes of dependent development in embryony. In the parallel variations of species, the supposition is thus that viable mutations could only have been such as caused the development of a more or less normal organism. Thus viable mutations in related species could only act on later independent processes of embryonic development and should impose no limitation on the crossing of related species. The only apparent limitation to such a cross, in the group studied, would be a possible a cumulation of lethal and sterility factors, i. e. factor arisen separately in each species due to mutation: in other words a limitation due to genetic isolation.

APPENDIX.

Note I: Dr. B. P. Uvarov in his identification of the species of *Aeolopus* states as follows: "*Aeolopus*, species near *thalassinus*, F. Usually called by that name, but actually a somewhat distinct species, undescribed at present."

Note II: Dr. B. P. Uvarov states that *Oedaleus nigrofasciatus* Deg. has a synonym, viz. *Oedaleus gracilis* Sauss.

Note III: In Figs. 120—125 are given some camera lucida drawings of mitotic and meiotic plates in a species of *Acrotylus* which is at present unidentified, but greatly resembling *Acrotylus patruelis* and *Acrotylus hottentotus*.

The testes in this species consist of 36 follicles as against 34 in *A. patruelis*. Unfortunately individuals of this species are scarce and of the few individuals caught not a single hatching has as yet taken place.

Note IV: In Figs. 126—131 are given some plates of the mitotic and meiotic divisions in a species which has been identified by Dr. B. P. Uvarov as *Oedaleus citrimis* Sauss. Individuals of this species are also relatively scarce and no hatchings have thus far taken place in the cages. These dissections have given fairly clear nuclei in the pachytene stage and it is noteworthy that in many bivalents in a nucleus either the proximal or distal ends remain unpaired. Taken either way this phenomenon gives strong corroboration to the statement that localisation of chiasmata is obligatory in the genera examined.

Note V: In Figs. 132—137 are given some mitotic and meiotic divisions in specimens which were identified by Dr. B. P. Uvarov as *Morphacris fasciata* Thnbg. This species is found in dry localities and breeds in the cages; it has only one generation per annum.

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Diagrammatic representation of meiotic chiasma formation.

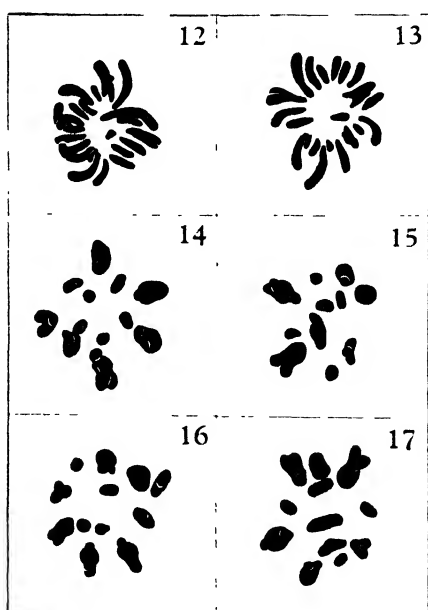
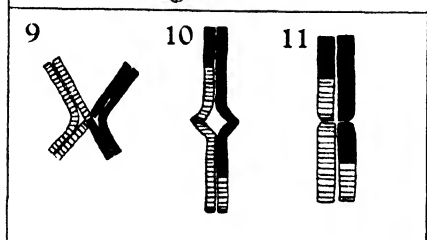
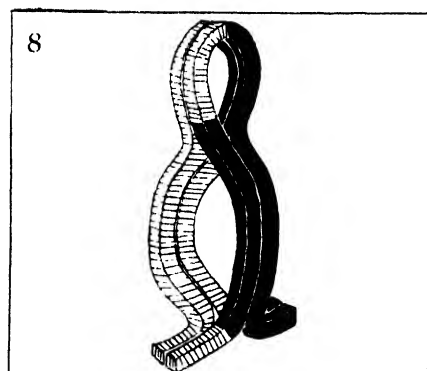
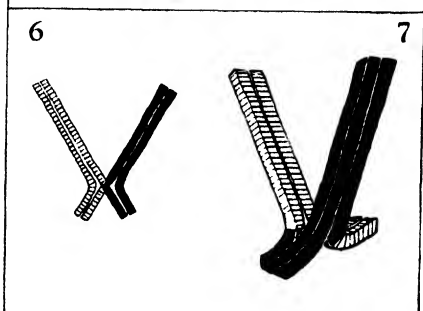
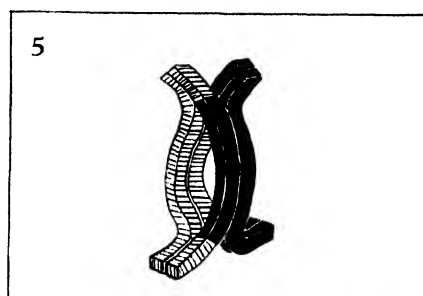
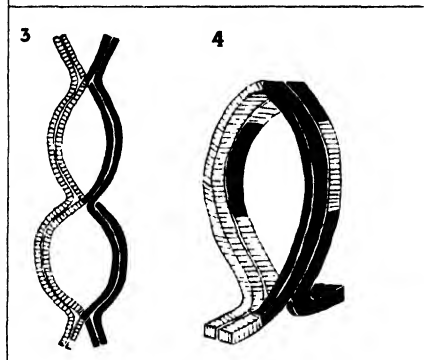
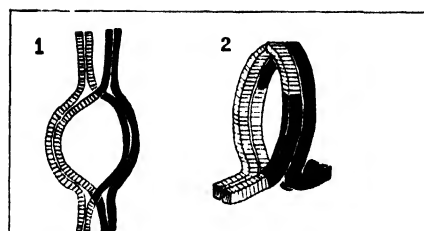
Fig. 1: Double cross-over or ring with two chiasmata during diplotene: the lower chiasma is localised and the two are compensating. Fig. 2: The same ring with the distal chiasma terminalised during metaphase. Fig. 3: Treble cross-over or double ring with three chiasmata during diplotene: the lowest chiasma is localised and the lower pair are non-compensating. Fig. 4: The same ring when the two distal chiasmata are terminalised during metaphase. Fig. 5: A ring of the second type with the distal or distributed chiasma unterminalised during metaphase. Fig. 6: A single cross-over or bivalent with a localised chiasma during diplotene. Fig. 7: The same bivalent forming a V during metaphase.

Diagrammatic representation of meiotic chiasma formation.

Fig. 1: A ring of the third type or double ring with the distal distributed chiasma terminalised during metaphase. Fig. 2: A bivalent with a single chiasma presumably localised, during diplotene. Fig. 3: The same bivalent with movement during diakinesis: this is the final configuration in metaphase in certain instances. Fig. 4: The same bivalent with full terminalisation in metaphase forming a rod configuration.

Acrotylus patruelis H.S. Figs. 12—13: Polar views of spermatogonial metaphase. Figs. 14—17: Polar views of primary spermatocyte metaphase.

All the figures of microscopical sections were drawn by means of camera lucida. The magnification of the drawings is approximately x 2500.

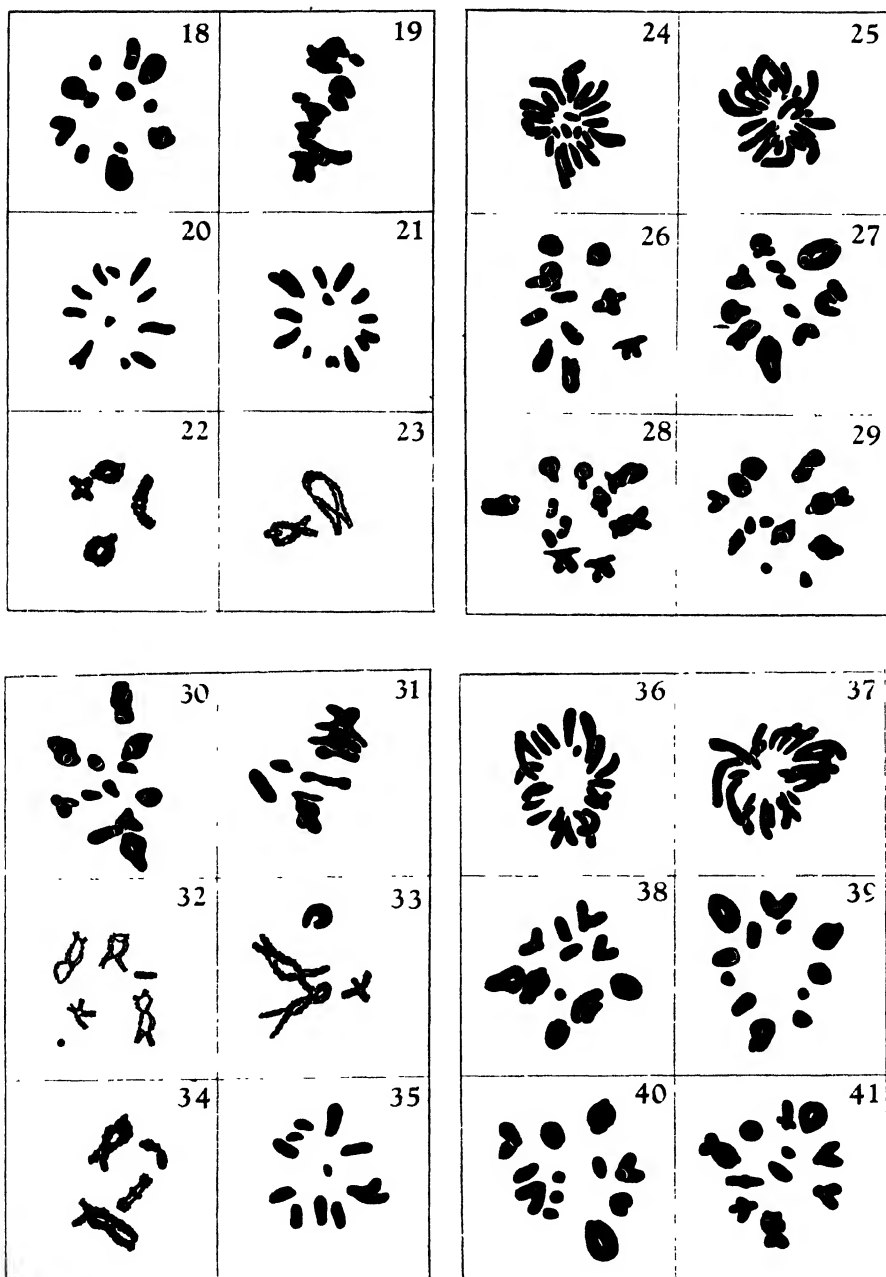


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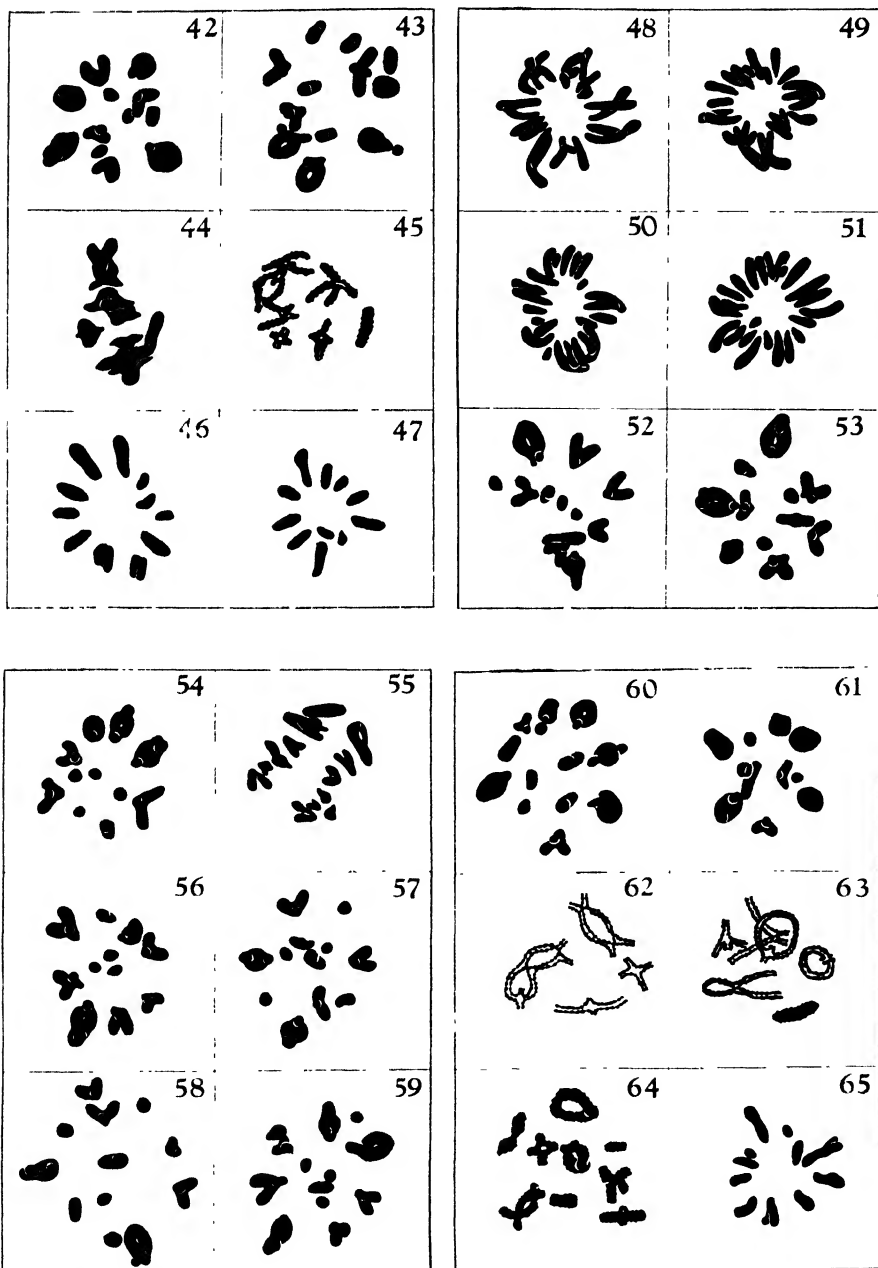


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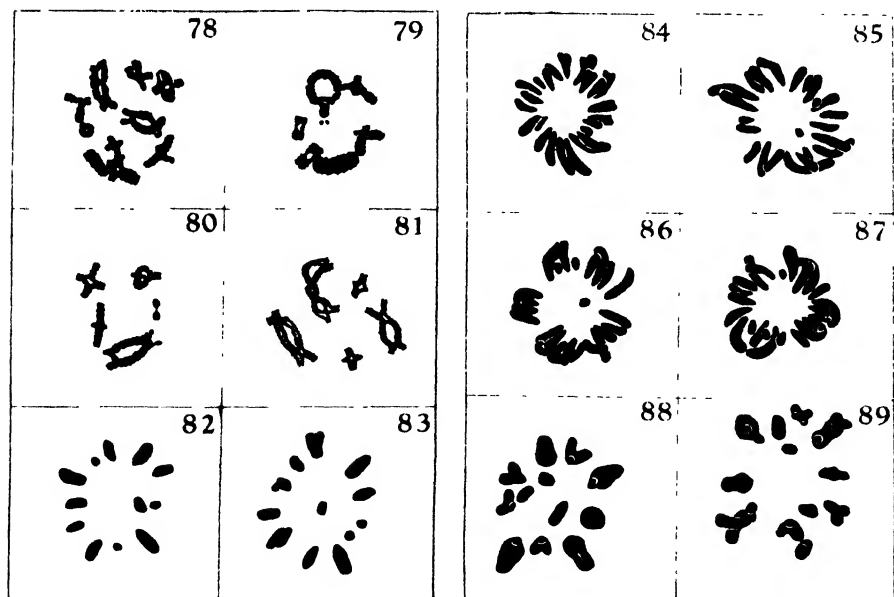
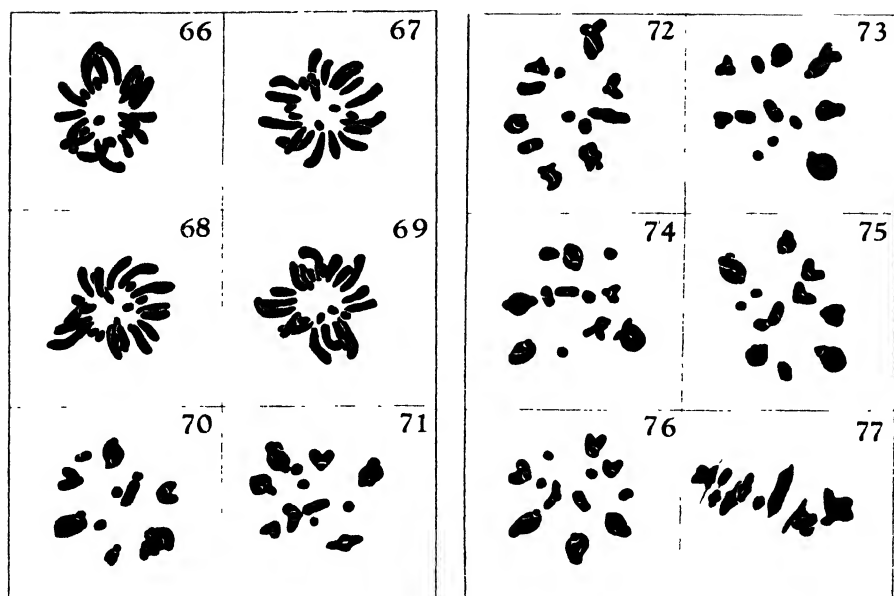


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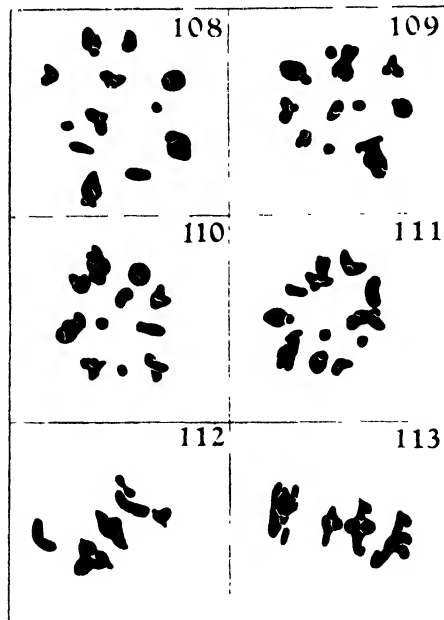
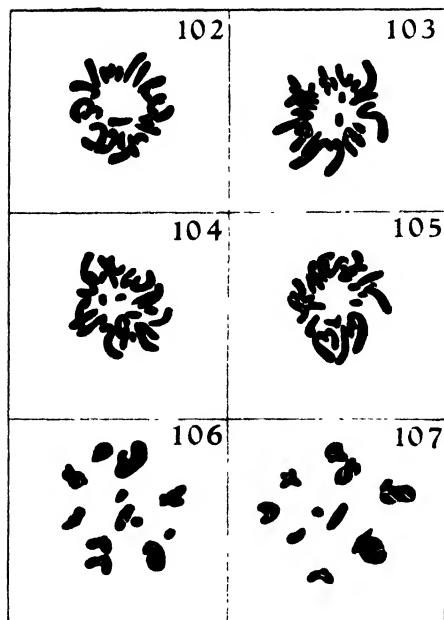
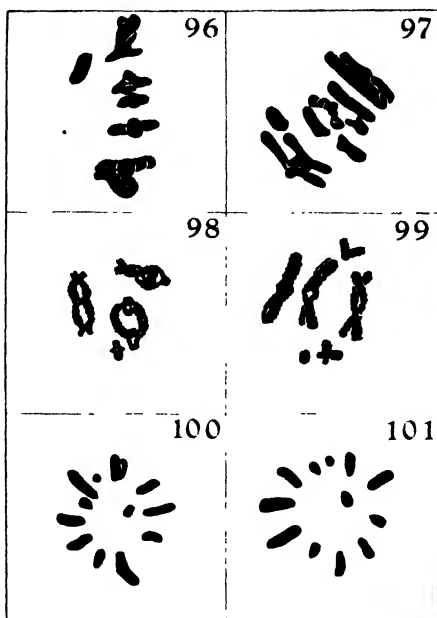
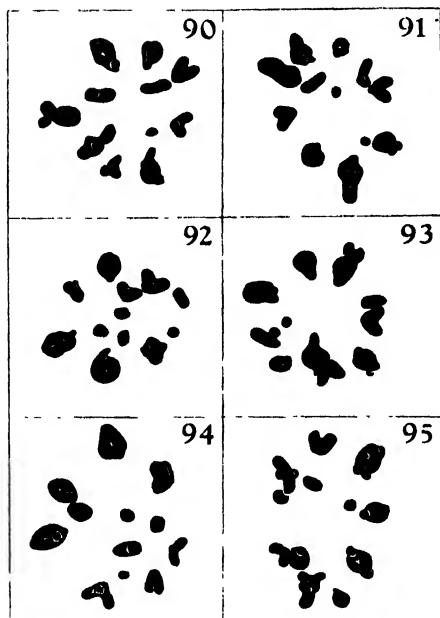


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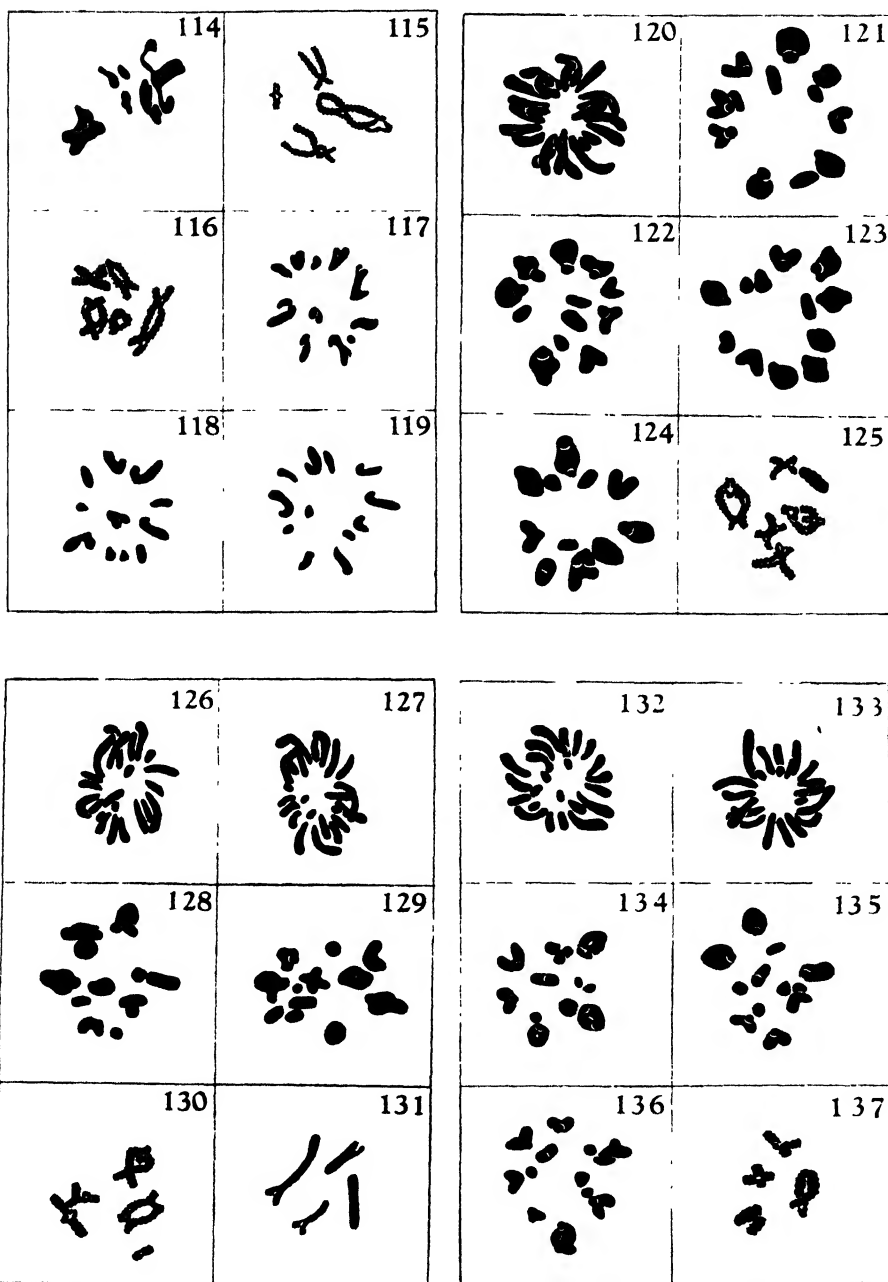


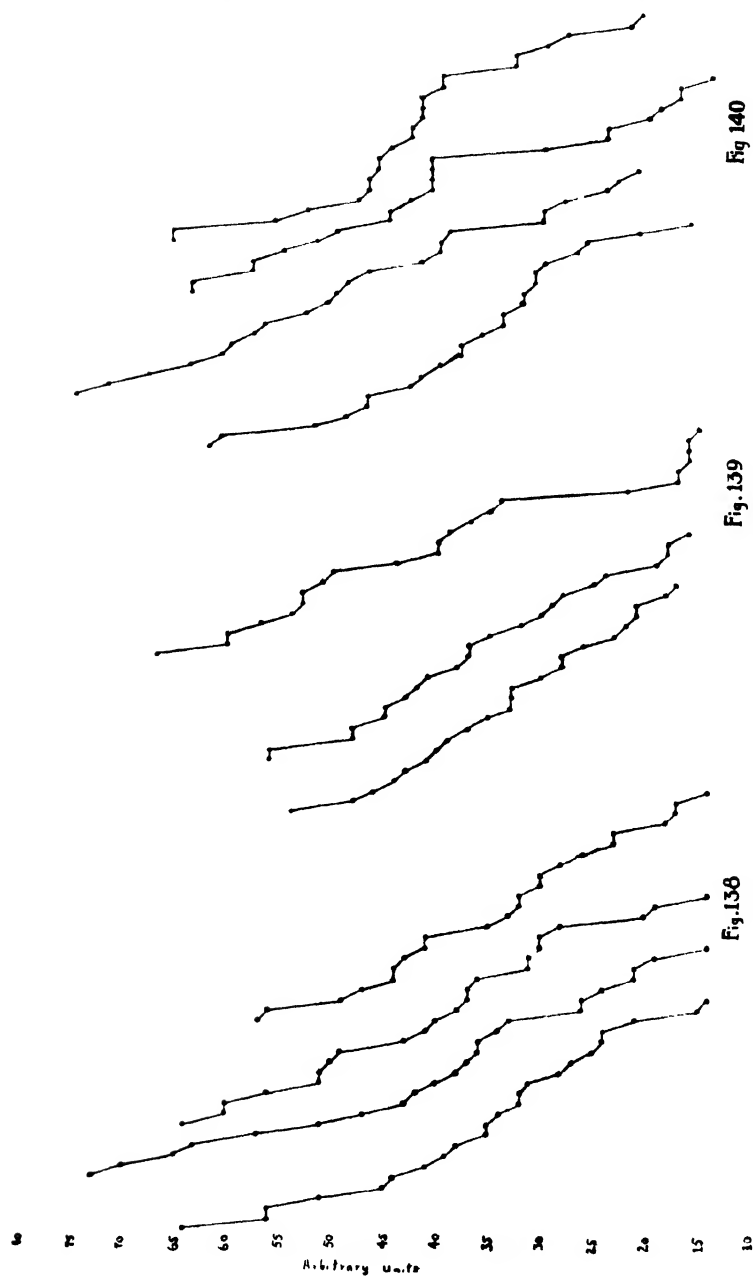
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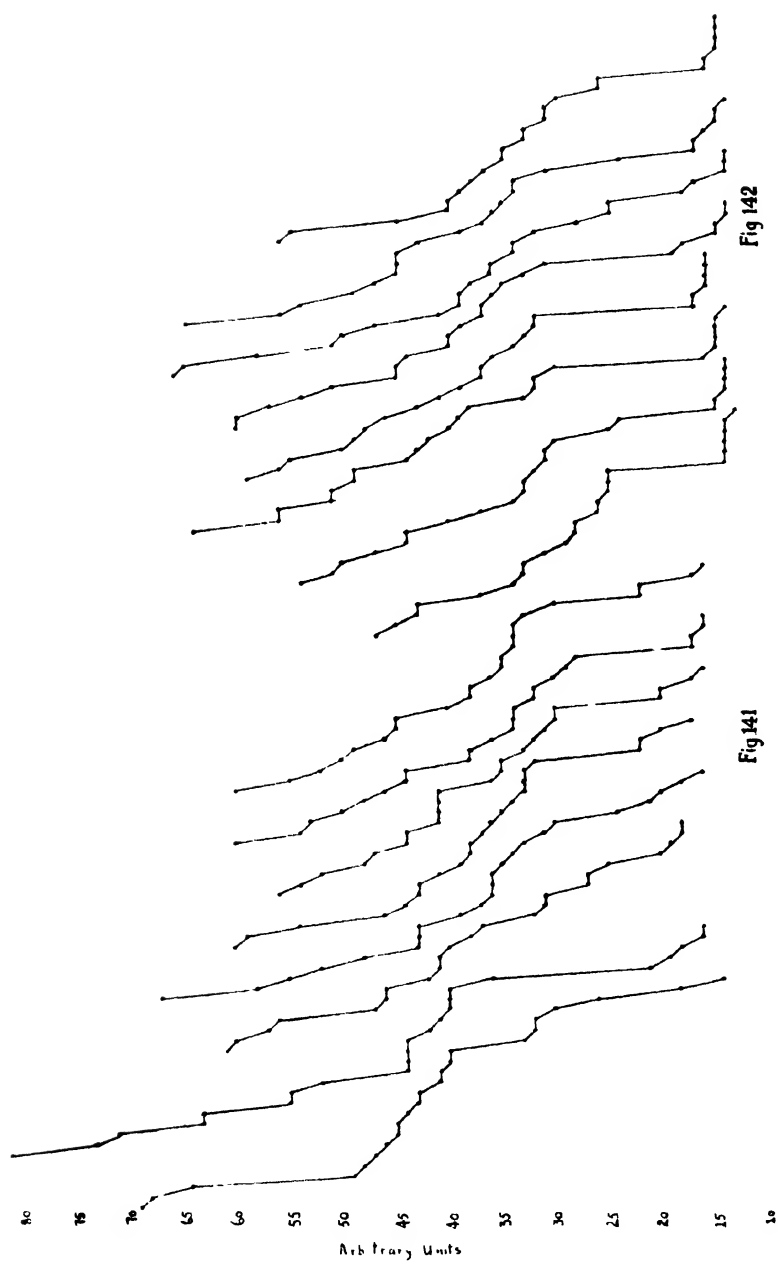
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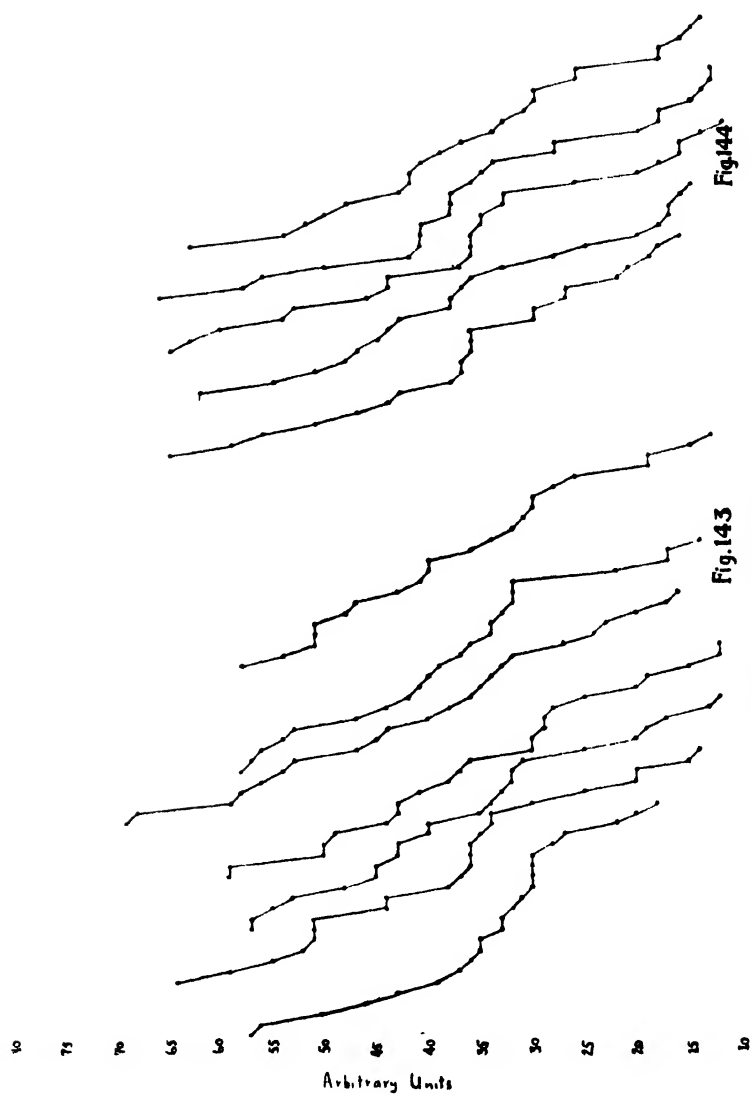
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*) Owing to an unfortunate error, this name was not printed in correct alignment on page 158 of volume I. Ed.

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